Editorial

ACCORDING to reports, interest is again being shown in the setting up of a third program for the ABC to relieve the pressure on the present stations when the broadcasts from Canberra fall due.

It is pretty safe to prophesy that this idea will be revived again and again until some solution has been found. The problem, of course, is that, when Parliament is on the air, the ABC is left with only one channel for most of the 24 hours.

Undoubtedly the broadcasts from Canberra have been much more popular than many anticipated, and it is equally unlikely that they will be abolished. It follows therefore that, because of this new and heavy drain on broadcasting time, the ABC should be given a substitute service so that its normal programs can continue.

The ABC has no alternative in the matter, either, and must put proceedings on the air when Parliament sits. It has no accurate knowledge of the time such sittings will occupy, and therefore no real opportunity to plan programs in any detail.

A third channel would mean facilities for Canberra, and possibly for State Parliaments as well. The extra broadcasting time available when the channel was not used for Parliament might be used to expand programs of good music. It would certainly ensure that Saturday afternoons on the air would bring us something besides continuous sporting broadcasts. As we have pointed out many times, listeners not particularly interested in sport are quite an army and they merit consideration.

One big stumbling block to a third program proposal is the crowded state of the broadcast band. One station would be needed in each State at least, and even these might not give desired coverage. The idea might throw stress once more on the possibility of using VHF for stations in the capital cities. It is a fact, however, that no country has been successful to date in attempting to introduce mixed VHF and broadcast band services. On the other hand, better quality programs do justice to high quality, and might yet be considered logical for VHF service.

The technique of using the same channel for more than one station carrying the same program has been used overseas. It might be applied in Australia with even greater prospects of success, as the stations will probably be better separated. These, however, are problems for the engineers. The first point to be considered is how to get the ABC out of its predicament—one likely to become more irksome as time goes on.

Finally, congratulations to Dr. E. G. Bowen, Radiophysics Chief, on his £15,000 award from the British Government for pioneer work on radar with Sir Robert Watson Watt. Australia is indeed fortunate to have a man of Dr. Bowen's calibre in such an important post. He is doing great work, recognised both at home and abroad.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

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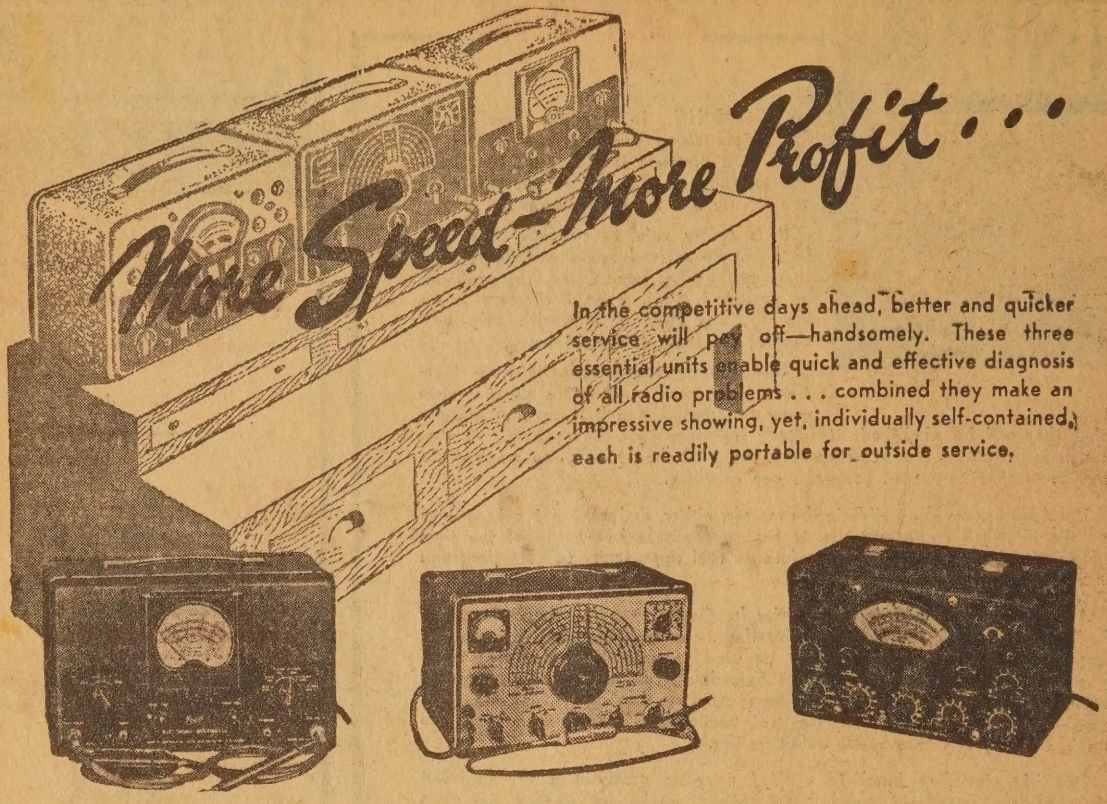

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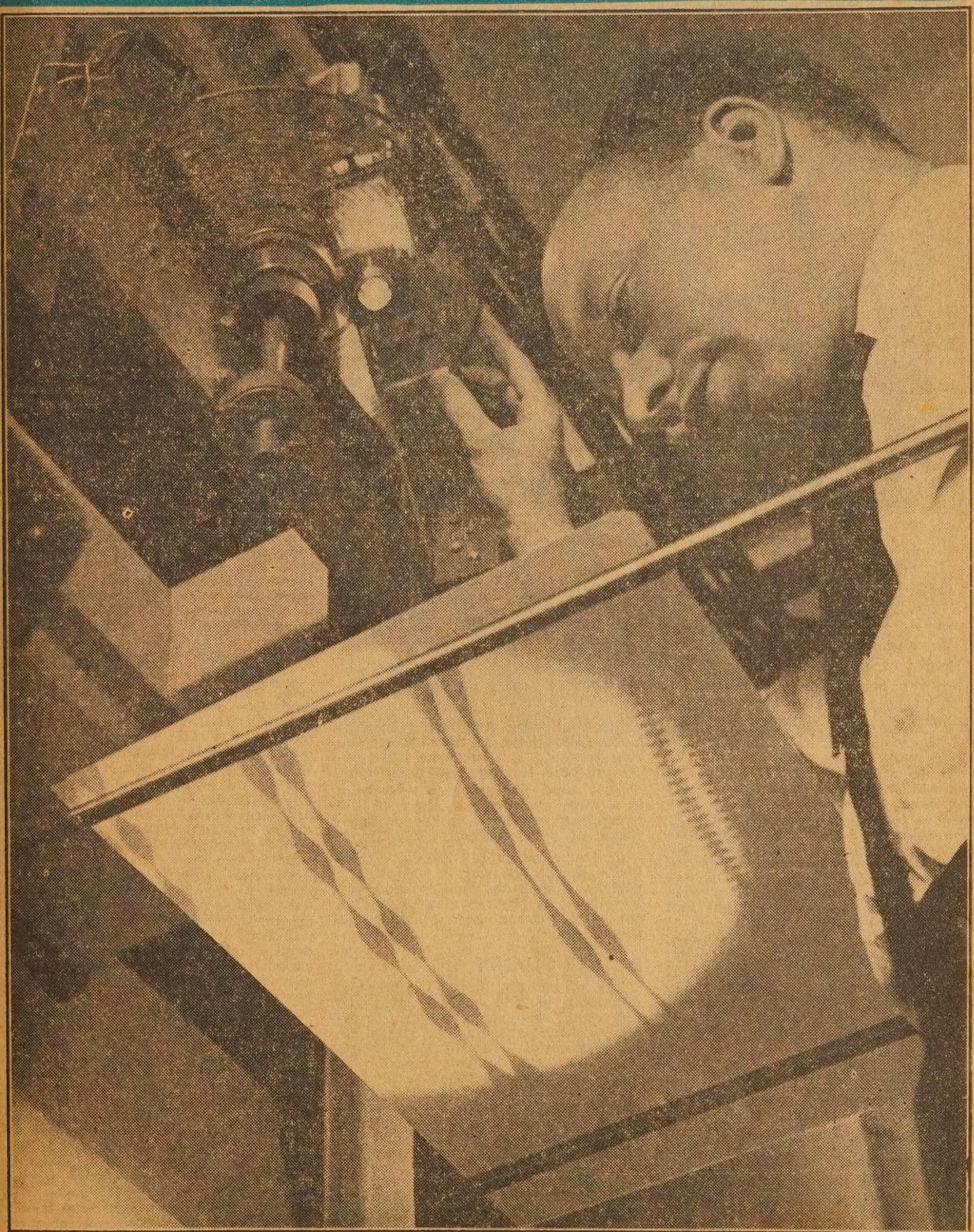
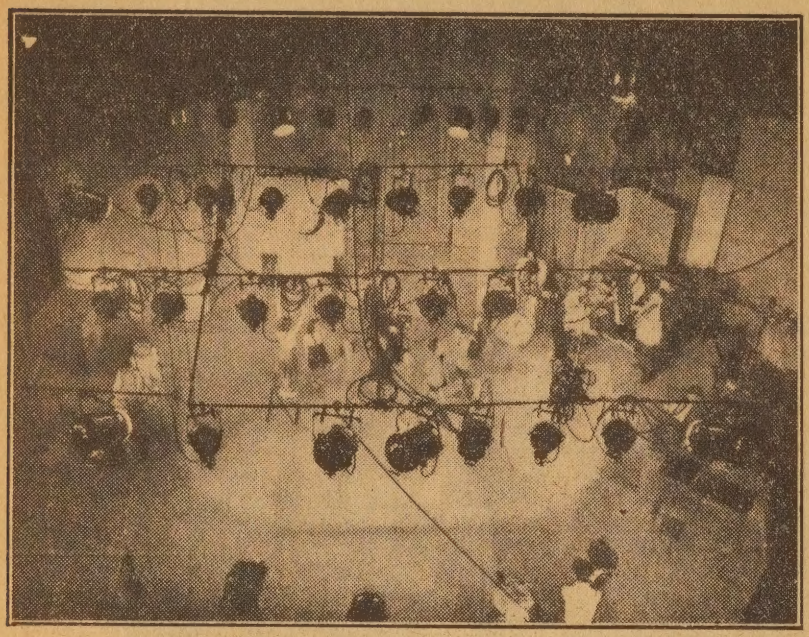
VISUAL SOUND TO GUIDE AIRCRAFT



Records of signals to assist in the radio-navigation of aircraft are made at the research station of the United Kingdom Post Office at Dollis Hill, London. Here is an enlarged image of the newly-photographed soundtracks thrown onto a screen for visual inspection. (Story page 11).

TELEVISION IN FRANCE TODAY



General view of a French television studio.

France is the only country to have made television progress apart from Britain and the United States. What are her ideas and plans for it? This article and interview, written for us by Jean Queval, gives an authoritative picture of French television today, and what we might expect to see in the future. In the light of USA freezing color, the plans in this connection are at present highly interesting.

BY nature television is the focal point of two influences, the radio and the cinema. It is not easy to ascertain which should be the predominant one. After receiving general recognition, it is now subject to many forms of pressure and threats to its existence, emanating from divers institutions for entertainment, particularly those of the cinema and sport. It gives rise to the most serious problems with regard to its influence, present and future, on society.

It tends to develop as an autonomous art of somewhat poor material resources. Lastly it is assuming at the present time, an essentially experimental character which makes it difficult to find an answer for all the doubtful points still arising after its short career.

DIRECTOR'S VIEWS

That is why we have asked M. Jean Luc, program director of French Television, for his views on these many aspects which are now becoming rather pressing problems.

Q: I should like to ask you in the first place what is likely to be the future of the 819 line standard that has been adopted by France and which makes it possible to produce the high definition picture with its unequalled precision on the screen.

As you know, we have equipped the Eiffel Tower station as an 819 line transmitter, but we are also continuing with 400-line transmissions from there so as to meet the requirements of those who have receivers built for less high definitions.

This bold use of high definition is a most significant feature of the prevailing tendency in French television: to work for better quality.

Q: But even on 819 lines the television picture is poor in comparison with the cinema picture—poor in particular as regards contrast value. Can you foresee any considerable improvement?

PICTURE QUALITY

There is no doubt that the greatest precision of the picture achieved does not exempt us—on the contrary!—from striving to attain its other qualities—stability, luminosity, clearness and, as you mention, a play of contrasts. There is also no doubt that we must not lose sight of the aesthetic example, the major precedent of the cinema. That is why we must try to continue cinematographical experiments instead of losing ground by disregarding or under-estimating it. You are thinking, perhaps, that this may be taken for granted. But it is a viewpoint subject to much discussion for superficial technical reasons. Considerable progress recently made is due to collaboration with cinema technicians. To them we owe our hopes of doing better still.

Q: I should like to have your opinion regarding the controversy between those who consider that television is more closely related to the cinema than to radio, and those who hold the contrary view.

Aesthetically, and up to a point, we might say filmologically, it is a controversy settled once and for all by the man-in-the-street when he says, "Television is the cinema at home." In both cases, television and cinema, pictures pass over a screen and in both cases, there is, now that the cinema is equipped with sound, an association between pictures on the one hand and music, dialogue and noise effects on the other, either in harmony or counterpoint. From this point of view, therefore, we have still to learn from the cinema. On the other hand, you know that we are developing under a statute linking us administratively with the Radiodiffusion Francaise. In this way, we are safe from industrial chaos and invasion by publicity, features that only too often characterise the cinema.

Q: But relations between the cinema and television are being developed in an atmosphere of wary competition, of bad-feeling we might say, if we think of the state of mind of some film exhibitors. May the technical similarities between the two means of expression lead us to hope that this period will soon terminate and give way to collaboration profitable to both?

TELEVISION & FILMS

Indeed, yes. In France there are some encouraging signs already. And the more television develops, the better will it be realised that its natural field differs from that of the cinema, despite technical similarities.

The aim of the cinema is to produce complex and highly perfected dramatic works. The future of television lies in productions for family and individual enjoyment. It also lies in the news features, variety items and reporting especially that link it with journalism, a journalism with which it is impossible for the cinema to compete, for lack of mobility, because it requires large capital difficult to amass and because its productions can inevitably only pay after a period of several years.

Cinema people are beginning to be aware of this aspect of the question. Take as an example the type of association represented by the televised news. The film Press is our partner in developing filmed news reports. Producers and distributors have accorded to us a number of old films that will enable us to balance our programs. Experiments such as the retransmission of performances televised on to the big screen of the Madeleine cinema reveal a desire for closer association in the form of co-operation as well as competition.

Q. — The daily news is probably the greatest success of French television. I am even given to understand that it is the envy of countries with a longer experience. In this respect

AS SEEN BY PROGRAMME DIRECTOR

however, may we look forward to the simultaneous retransmission of events, which would mark further progress over the film shown after the event, even if it is a question of minutes.

We may look forward to the regular organisation of such a feature, but not in the immediate future. It is above all a question of material means. We are relatively poor as regards material means. Bear in mind the fact that our annual budget is less than that of the production of one big film! So our constant policy is to maintain French quality, which lies in skilled craftsmanship and artistic imagination, rather than in an accumulation of means.

PROPAGANDA

Q.— The radio is a terrible means of spreading propaganda and perhaps stupidity if it be used maliciously or simply badly. But the danger is limited by its purely auditory nature, and thus by the habitual inattention it produces in many cases. In short, radio for countless listeners is merely a phenomenon that adds a certain emphasis to their daily lives. But television demands full attention and, like the cinema, is able to cast its magic spell. A day that is conceivable, when it replaces the radio in most homes, risks being an evil day. How is such a risk to be averted?

I think that television should act as a means for cultural decentralisation, and bring something of town-life into inaccessible places. I regard it as a provincial and country feature. After all, a good televised show, the same as for Paris or Lille or Lyons (where our next transmitter is to be established) is worth more than a bad dramatic company in a second-rate play, or than the wretched dubbed films abundant in French country districts.

But everything of course will depend on the merit of our programs. For our part, I would insist the keyword is quality. We shall try to apply it to a type of production which in accordance with a specific aesthetic and technical formula, adapts the implicit doctrine of the Radiodiffusion Francaise, which is to entertain, to inform and to teach.

COLOR TELEVISION

French engineers, under the auspices of the firm Radio-Industry, have been making experimental broadcasts in color. At the same time, the American firm CBS (Columbia Broadcasting System) has established its method in the United States, where color broadcasts have taken place regularly since the 25th of last June.

A technical agreement was reached, by which the CBS was able to make the successful demonstration in Paris on September 13. The originality of the method lies in the fact that it is additive, in contrast to the method used in the cinema, which is subtractive. That is to say, three primary colors — red, green and blue—are projected successively, hence the name "continual" or "sequential" method. Naturally this succession occurs in a short enough space of time for the addition of the colors to be made without discontinuity.

The televised image, as we know, is obtained by the juxtaposition of numerous tiny points arranged in lines. The whole forms the texture of the image. So we may imagine how the images follow one another at each stage in the breaking up of the web, point by point, line by line, image by image. This last conception is the important one, so we can now complete our definition the method is called the "sequential web method." The webs —red, green and blue—succeed each other at a frequency of 144 per second. The corresponding line frequency is 29,160.

This last item of technical information is not mentioned without good reason. In the methods used in black and white television of so-called low definition (300 or 400 lines, or more), the screening frequency is less rapid by half. That is to say, that these methods do not allow the use of color in the way just described. France then is fortunate in possessing sending and receiving sets of the 819 line system.

She is fortunate in two ways. Firstly, in that the technical difficulty of mastering color is solved. But, above all, in that the French sets on the 819 line system are equipped to receive broadcasts both in color and in black and white. For it would be wrong to suppose that the mere fact that color transmission has been invented means that it should be used for every program. For a long time yet, certain programs will be better in black and white, and others are not technically possible in color.

In this way, M. Wladimir Porche, Director-General of French Broadcasting and Television, was able to say, "Future programs will not all be transmitted in color. Many films and news bulletins, in particular, will still be in black and white. All receiving sets will necessarily have to be equipped for black and white reception, as this will often be the only kind of program. The public can be assured, without reservation, that the present-day French set of high definition will neither be useless nor out of date when color has come to stay."

This assurance is of great import-

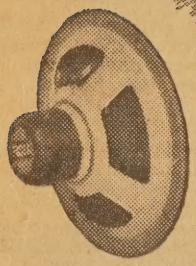
French citizens show the greatest interest in displays at a recent exhibition of television.

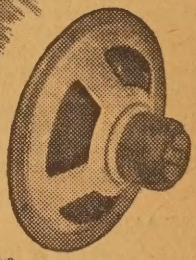
ance for extending the sales of television sets. On the one hand, all the major technical problems of television have now been overcome by engineers; but, on the other hand, as they were pursuing their work, the leading technicians noted a certain divergence in their ideas on equipment. France, therefore, is equipped with sets of both medium and high definition. The assurance that the latter will be perfectly satisfactory for all broadcasts to come should help to dispel the last fears of those who are a little distrustful of predicted improvements.

The second handicap, the wider distribution of television broadcasts in France, lies in the fact that there are only two transmitting stations, those in Paris and Lille. The projected equipment scheme predicts the erection, in the near future, of a third transmitting station at Lyon. Even then, since each station covers only a radius of 120 kilometres, not even the whole of the metropolitan area will be covered. In short, it is chiefly funds that are lacking. For, all things being equal, our engineers and technicians are certainly capable of placing French television right in the front rank.

ROLA ANNOUNCES EFFICIENT NEW C.B. SPEAKER

Six-inch Model First of a New Range





To incorporate in its range of domestic loudspeakers a new and very efficient centre block magnet system developed by its engineers Rola Company (Aust.) Pty. Ltd. has embarked on a sweeping retooling programme.

Such re-tooling is an immense job, one which could only be carried out in a big and modern plant like Rola's. It will take time to complete but Model 6H, the first of this new *"Fluxmaster"* series of Rola loudspeakers, is now coming off the production lines and other new models will follow soon.

The centre block principle is not new — such units have been used in loudspeakers for years but, in general, have been inefficient because they have not made full use of the energy content of the magnet.

To appreciate this point, glance at Figs. 1A and 1B which show two typical centre block speaker magnet constructions. One uses a straight cylindrical magnet only and the other a cylindrical magnet topped with a "stepped"

FIG. 1.A.

FIG. 1.B

pole piece the diameter of which decreases in the air gap.

To ensure that maximum energy will be developed across the air gap it is essential that the magnetic circuit be designed so as to keep leakage to a minimum. This is not possible in the designs illustrated in Figs. 1A and 1B.

The Anisotropic type of magnet used in modern loudspeakers has optimum magnetic properties along one axis. In the magnet assembly of Fig. 1A the magnetic lines of force are asked to turn, in the air gap, at right angles to this preferred direction and so losses are introduced.

This fault is overcome in the assembly shown in Fig. 1B by placing a mild steel pole tip on top of the magnet. This pole tip collects the flux from the magnet and leads a portion of it across the air gap. However, because of the size and shape of the pole tip large leakages take place.

Rola's solution to this problem was to place a thin

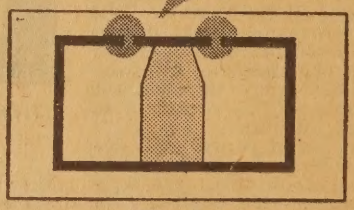


FIG. 2.

steel "collector" on top of the magnet. Its purpose is to gather the maximum magnetic flux and to concentrate it in the air gap—the place in which it will do most good. (See Fig. 2). This ingenious magnetic circuit was first introduced in the famous Model 12-0 and its even more illustrious cousin Model 12-0x. Its use in the 5, 6 and 8 inch models of the new *"Fluxmaster"* series will mean that these smaller speakers, too, will have many of the characteristics which made Models 12-0 and 12-0x famous as examples of outstanding loudspeaker engineering.

BRITISH POST OFFICE IN RESEARCH

No service is more truly international than that of the British post office. Not only do its activities span the whole world, but there is a free interchange of information on new techniques and developments between the postal authorities of many countries. A discovery made in London or Paris today may tomorrow mean speedier postal facilities in countries in other parts of the world.

MANY postal authorities have their own research departments whose constant aim it is to improve the equipment and technique used in the day-to-day operations of the post office and in radio, cable, telegraph, and telephone communications. That maintained by the United Kingdom Post Office at Dollis Hill, London, has in the past made considerable contributions to the science of communication.

LONG DISTANCE TRUNK SIGNALLING FOR TELEPHONES

Since its foundation at Dollis Hill in 1922 it has perfected the long distance trunk signalling system for telephones (now standardised by the post office); supplied standard clocks to the Astronomer Royal and designed the cable systems which link the London television studios with the Birmingham and Manchester television transmitters.

Most recent of its developments has been the designing of deep water

Special
By JOHN RIGG

submerged repeaters for use on the 700 miles (1126 kilometres) long submarine telephone cable to be laid next year between Newfoundland and Nova Scotia by Cable and Wireless Limited.

The United Kingdom Post Office has been in the forefront of development in the field of submerged repeaters and a number of repeaters (a sort of electronic "booster," which amplifies cable signals) have already been laid in shallow water cables between Britain and Europe. The new submerged repeater, however, represents the first attempt in this country to design a unit for deep water ocean cables which (in the case of the Newfoundland-Nova Scotia cable) will go down to depths of up to one and a half miles (2.42 kilometres).

This is but one of the developments engaging the attention of research engineers at Dollis Hill. A simplified radio-telephone system has been produced to enable a normal telephone service to be given to subscribers living in out of the way places such as islands off the coast to Scotland. This system is of great value in cases where the provision of a submarine cable or of an extensive overhead line would be costly and difficult.

TALKING CLOCK FOR AUSTRALIA

Much other work of international value has taken place recently in the Research Branch and the Radio Experimental branch, which together form the Dollis Hill Research Station. A prototype model of the mechanism of a new "talking clock" designed for the Australian Government has for example been completed there recently. This clock incorporates what is known as a crystal-controlled oscillator — it depends for its accurate time recording on a type of quartz crystal which vibrates with a very high degree of constancy.

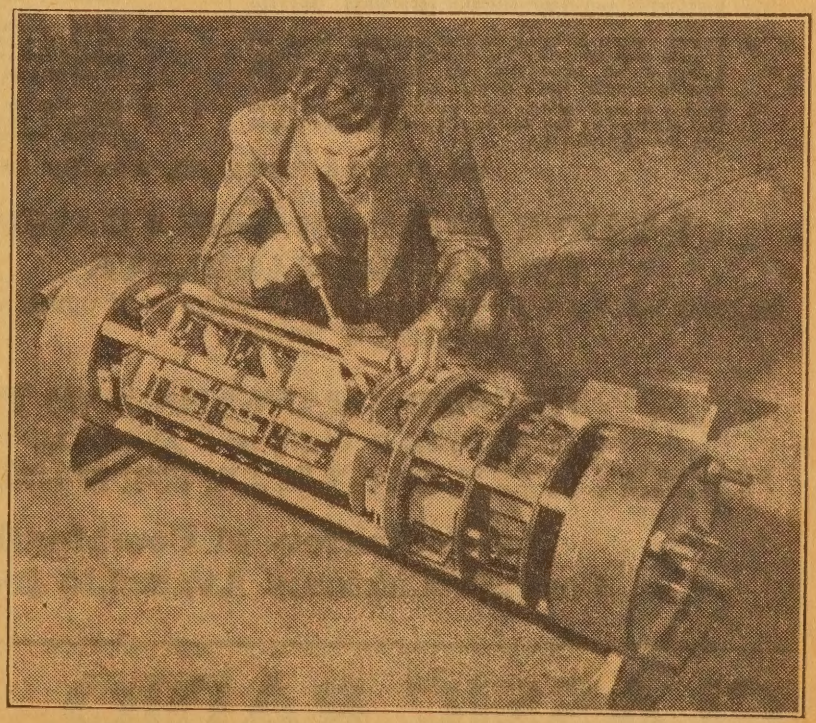
The official time system in Britain is the concern of the Astronomer Royal and the Post Office has contributed to this work by developing special clocks using very high grade quartz crystal oscillators. So accurate and stable are these clocks that, as a standard of time or frequency, they rival the mean rate of rotation of the earth which is the primary standard.

SHORT WAVE RADIO FOR TELEPHONE AND TELEGRAPH SERVICES

The increasing use of short wave radio for telephone and telegraph services has increased the risk at large radio stations of aerials being obstructed by neighboring aerials or buildings. In the past the only way to test the suitability of a site and of the effect of obstruction was by costly trial and error.

Now post office engineers in Britain have constructed a scale model of a short-wave aerial one hundred and fiftieth the size of an actual aerial, whose wave length is also reduced to one hundred and fiftieth. By rotating this model aerial close to models of possible obstructions—masts, steel framed buildings, and so on—the degree of obstruction they are likely to present may be measured.

A new method of assessing in the laboratory the relative difficulty of talking over different telephone lines (by which two persons play a kind of question and answer game with designs which must be described by one and recognised by the other); an automatic inflammable-gas detector for use in underground cable tunnels; and a new method of cutting synthetic crystals with wet string—these are also among many other developments available to post office administrations throughout the world as a result of the developments by engineers at Dollis Hill.



A submarine repeater, developed at the research station of the United Kingdom Post Office at Dollis Hill, London. This acts as a "booster" which amplifies cable signals.

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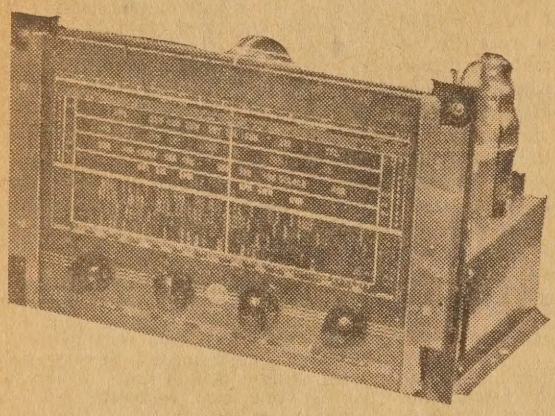

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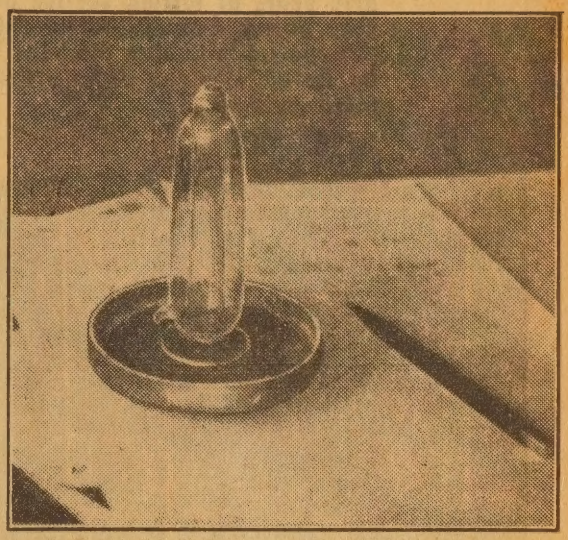
IONISED GAS WORKS NEW SPEAKER

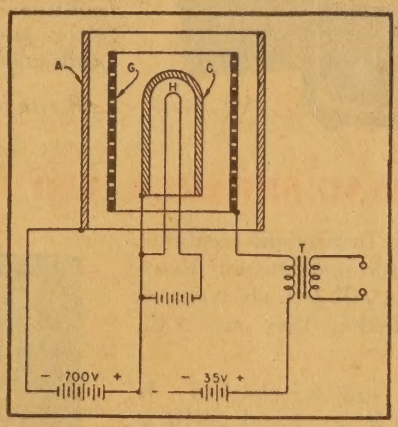
Overseas reports have credited a young French physicist with the development of a revolutionary type of loudspeaker which has no mechanical moving parts. Sound waves are generated by the direct expansion and contraction of air, the temperature of which is varied electronically.



A closeup of the ionisation unit, the opening being down. It utilises the general phenomena which have been responsible for peculiar effects like "singing arcs."

☆

Below is shown the circuit of a developmental "triode" model which worked better than the diode but was still very inefficient.



IF the ideas of the inventor, S. Klein, can be transformed into a commercial reality, the way will have been opened to eliminating one of the most serious barriers to high fidelity reproduction—the inherent mass and resonance effects of a conventional loudspeaker cone.

Klein's efforts are said to have resulted in the development of a unit which has emerged from the stage of being a scientific toy and which is being lined up for production by a French components manufacturer.

EDISON "THERMOPHONE"

In some ways, the new speaker recalls the efforts of Edison with his "Thermophone." In this instrument, a heated wire was passed down the throat of a horn, affecting the temperature of the surrounding air. As the temperature of the wire was varied, so did the surrounding air expand or contract, setting up a periodic wave motion in sympathy with the current variations through the wire.

The limitation of this device was in the thermal lag of the wire which allowed the "speaker" to function only at very low frequencies. Klein's efforts have been towards eliminating the wire and varying the air temperature directly.

The key idea behind Klein's approach is that heat is closely linked with molecular motion so that the problem becomes one of producing and controlling molecular agitation in free air.

EARLY ATTEMPTS

In the first model, a robust indirectly heated cathode was used in which the thermal agitation was sufficient to produce free ions from the surface of the parent material—in other words atoms which had become positive by loss of an electron through emission.

A cylinder carrying a high negative charge surrounded the cathode and attracted the ions already mentioned, together with other atmospheric ions created by collision. The whole device could be likened to a large diode operating in free air. It was not practical, mainly because a total power of the order of 500 watts was required to maintain and vary the potentials sufficient to produce even a low volume of sound.

A "triode" structure was then tried (Figure 2), but, while an improvement, still suffered from very low efficiency.

The latest and the current model, which is about the same size as a teacup, uses a different principle of operation in that the ions are agitated within a form of electrical capacitor rather than being emitted from cathode to anode.

Although physical details are lacking, Figure 3 suggests a likely form of construction for the "ionophone," as the device is called.

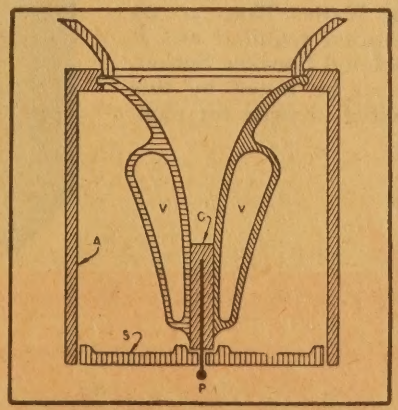


Figure 3. The latest "ion" speaker is more like a complex capacitor in which the ions are agitated by combined high frequency and DC fields.

A fine, platinum heater wire "P" passes through the centre of a quartz cylinder, "C," which is coated in turn with a compound rich in ion emission. The compound is said to involve platinum, aluminium phosphate, graphite and iridium.

HORN RADIATOR

The cathode cylinder is sealed into a short quartz horn, with evacuated walls "V," and this is coupled in turn to a larger radiating horn of the conventional variety. "S" is the supporting washer, while "A" is an outer metal shell.

The ion emissions from C are subject to a high frequency field (about 400 kc) and a DC potential of about 10,000 to 12,000 volts.

The cathode region is heated initially by the platinum wire and later by the dielectric losses and ion activity resulting from the high frequency field.

The concentration of heat near the cathode surface rarefies the air and assists in ion movement.

LIKE CAPACITOR

The whole assembly may be regarded as a large and very complex capacitor between whose plates—the outer shell and the platinum wire—exists a cloud of ionised particles in a constant state of agitation.

By changing the intensity of the fields within the condenser, the ion movement is varied, and with it the heating effect on the contained air. A periodic variation in the field produces a periodic variation in air volume, with a consequent audible output.

Whether the device defeats problems of thermal delay and whether it can be reduced to a relatively simple piece of gear yet remains to be demonstrated.

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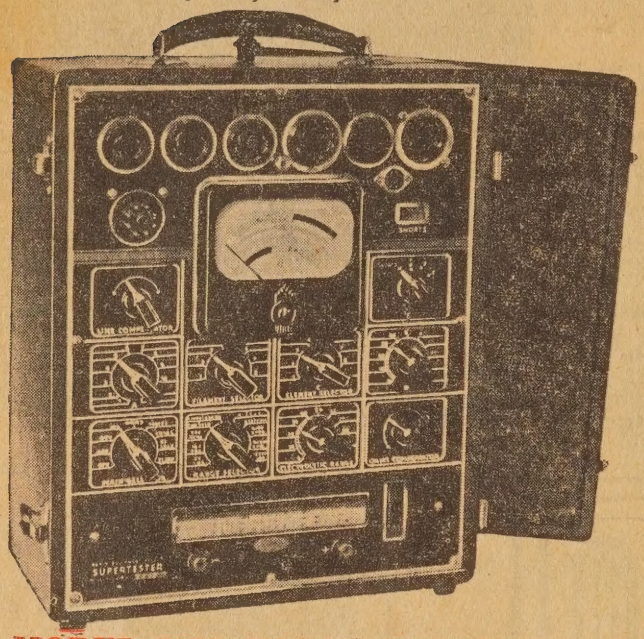

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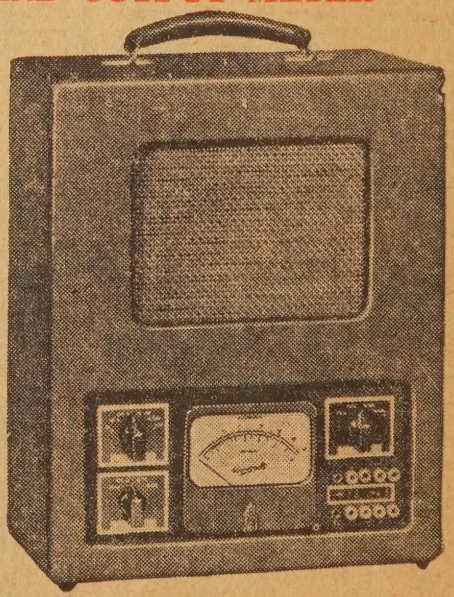

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A HORSEPOWER FROM A CYCLIST

How much power does a cyclist expend in climbing a hill or winning a road race? How efficient a machine is he? This unusual Popular Science article gives you the answers.

THERE is no really reliable data on the resistance of a cyclist, but is is possible to form a shrewd estimate from motor car tests. It is at the tyres that most of the road resistance is set up; friction of the transmission is relatively small, for even in a car beyond the engine practically all the bearings run on balls or rollers.

With a car on a good road surface this road resistance may be put at about 40lb a ton. Allowing, then, for the difference between a free and independent track and two tracks tied together as it were, resistance at the tyres of a cycle might reasonably be put at less than half that of a car.

Add to this the slightly less proportionate resistances in the transmission and the greater proportion of live to dead weight in a cycle, and we shall not be far out if we put its road resistance at about 18lb a ton.

Supposing, then, that a cyclist and his machine together weighed 200lb, and presented 5½ sq ft to air resistance, at 11 miles an hour on the level his rolling resistance would come to 1.611lb, air resistance to 1.871b, and he would be giving out .102 horsepower—just over one-tenth.

Up a gradient of 1 in 30 at eight miles an hour he would have to develop .057 hp in propelling his machine, but, up the hill, would also have to raise it and his own weight at the rate of 23-47ft a minute, which would take another .142 hp—total .199 or just short of one-fifth of one horsepower.

At five miles an hour up a rise of 1 in 10 he would have to raise himself at the rate of 44ft a minute, and this would absorb .267 hp, while the mere work of pushing the machine along at five miles an hour would only take .027, making .294 hp in all, or just less than two-sevenths of one horsepower.

RESISTANCE AT 20 MPH

At 20 miles an hour air resistance would be relatively high (6.491b), and at that speed would account for .346 out of the .432 hp necessary.

These figures will give a fair general idea of the power the rider gives out on the level or uphill. Free-wheeling downhill, however, he would, of course, be travelling without exerting any power directly, and only so indirectly if he was coasting at less than his average speed and consequently had to pedal the harder elsewhere to make up time.

But free-wheeling faster than his average speed the opposite would be the case, and the run downhill would "make up time" for him, enabling him to go at easier speeds farther on and yet maintain his average. It would then simply mean that the work he had put in by raising himself and his machine up the hill was being given out again downhill faster than was required for his average speed. He would be getting some of his own back, and faster than he paid it out.

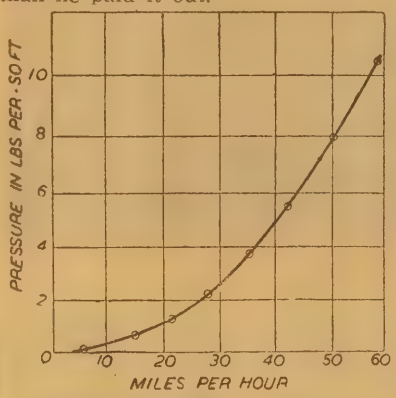

Chart plotted from actual wind resistance tests.

For convenience of reference and comparison the foregoing figures for cycle and car are given here in tabular form:

CYCLE SPEEDS AND GRADIENTS	
29 mph, level	.432 hp
11 mph level	.102 hp
8 mph up 1 in 30	.199 hp
5 mph up 1 in 10	.294 hp
CAR SPEEDS AND GRADIENTS	
59 mph, level	39.33 hp
35 mph, level	10.45 hp
27 mph, up 1 in 30	11.43 hp
20 mph, up 1 in 10	15.34 hp

COMPARATIVE EFFICIENCIES

But the comparisons possible between a living engine and a metallic man-made one are strictly limited, especially in efficiency. A car engine will do so much work for so much fuel and there the matter ends, simple and clear-cut.

With the human machine, however, it is not possible to calculate in watertight compartments, as it were, like this; we cannot say where the effect of one day's or one meal's fuel begins or ends. Thus the nearest comparable conditions are when both "machines" are similarly doing their utmost over extended periods. Let us investigate the "all out" conditions then in each case.

A MAN'S FUEL

Of course, his fuel will vary according to his individual constitution and requirements, but as a rough average it is generally reckoned that the daily food of a man doing light or moderate work should contain about 10,000 to 11,500 B.Th.U. for moderately hard work, 11,750 to 13,000, hard work, 13,500 to 16,500; and very hard work up to 22,000 heat units. The university boat race crew average about 16,000, lumbermen, 22,000 to 23,000.

Supposing the cyclist is out for a 12-hour record, he would certainly need a special dietary fully equivalent to that of the lumberman. Suppose we gave him 24,000 heaht units for the day's work. That, if converted without loss into work, would mean 18,540,000 ft-lbs. But the work that he will do, in actually propelling his machine at a steady 20 miles an hour for the 12 hours, would be only 10,264,320 ft-lbs, which is 55.37 per cent of the total work value of the fuel. And quite enough, too.

In other words, the rider's efficiency is 55.37 pc as against only 23 pc for the car engine, which at least will give you some idea of how far man's achievements are still behind Nature.

WEIGHT, HILLS AND WIND

We have already dealt with the power exerted by a cyclist under a few typical conditions and of how he compares with a car engine in this matter, but some rider may want to know how variable external factors, such as weight, hills and wind, may affect him.

To get at this information, calculations must be made more analytic-

(Continued on Page 94)

H.P. Uphill at Various Speeds

Gradient		1 in 8	1 in 10	1 in 12	1 in 16	1 in 20	1 in 30
Speed m.p.h.	Resistances						
3	Road and air	.013	.013	.013	.013	.013	.013
	Hill	.190	.152	.127	.095	.076	.051
	Total ..	.203	.165	.140	.108	.089	.064
4	Road and air	.019	.019	.019	.019	.019	.019
	Hill	.253	.203	.169	.127	.101	.068
	Total ..	.272	.222	.188	.146	.120	.087
5	Road and air	.026	.026	.026	.026	.026	.026
	Hill	.317	.254	.211	.159	.127	.085
	Total ..	.343	.280	.237	.185	.153	.111
6	Road and air	.034	.034	.034	.034	.034	.034
	Hill	.380	.304	.253	.190	.152	.101
	Total ..	.414	.338	.287	.224	.186	.135
7	Road and air	.044	.044	.044	.044	.044	.044
	Hill	.444	.355	.296	.222	.177	.118
	Total ..	.488	.399	.340	.266	.221	.162
8	Road and air	.055	.055	.055	.055	.055	.055
	Hill	.507	.405	.338	.254	.202	.135
	Total ..	.562	.460	.393	.309	.257	.190
9	Road and air	.067	.067	.067	.067	.067	.067
	Hill	.570	.456	.380	.285	.228	.152
	Total ..	.637	.523	.447	.352	.295	.219
10	Road and air	.082	.082	.082	.082	.082	.082
	Hill	.634	.507	.423	.317	.253	.169
	Total ..	.716	.589	.505	.399	.355	.251
11	Road and air	.100	.100	.100	.100	.100	.100
	Hill	.696	.557	.463	.348	.278	.186
	Total ..	.796	.657	.563	.448	.378	.286
12	Road and air	.119	.119	.119	.119	.119	.119
	Hill	.760	.608	.507	.380	.304	.203
	Total ..	.879	.727	.626	.499	.423	.322

A striking picture taken in New South Wales showing a number of lightning flashes striking the ground.

causes the flicker in the light given from a flash of lightning, when it discharges to ground.

A flash of lightning is made up of several partial discharges which follow each other along the same path at intervals of approximately one-thirtieth of second.

Now it will be remembered that when a flash breaks from the cloud to earth it carries the negative charge from the base of the cloud.

When it approaches the ground, a positive return streamer meets it and travels back to the cloud with a brilliant burst of light along the same path taken by the downward discharge or "leader."

Let us suppose there are three separately charged portions of a cloud side by side as described above.

When the positively charged return streamer enters the cloud, that portion of the cloud will have been completely discharged and a conducting channel has been formed from the cloud to earth by the breakdown of the air along the path of the first flash.

The adjacent charged portion of the cloud is then discharged by making connection inside the cloud with

MORE ABOUT THUNDERSTORMS

Colossal voltages and currents are developed when lightning flashes during a big thunderstorm. The analysis of how it happens is a fascinating subject. This month, Calvin Walters has some further information about what happens in a thundercloud.

But to him who's scientific
There is nothing that's terrific
In the falling of a flight of thunderbolts;
Yes, in spite of all my meekness,
If I have a little weakness
It's a passion for a flight of thunderbolts.

WHEN Gilbert and Sullivan wrote this verse into their opera, The Mikado, they were not quite correct. Science had not advanced to the stage where the mechanism of the thunderstorm was clearly understood.

A thunderbolt, at that time, was really something terrific to all and sundry (including scientists), in spite of Gilbert's assertion, but we have advanced a little since then.

In last month's story of the thunderstorm we saw how the thundercloud is developed by opposing currents of warm and cool air. We saw how these upward currents cause the electrification of the cloud into a negative base and a positive top and how the cloud is discharged to the ground by means of the flash of lightning.

The story created such interest that we decided to carry the matter a little further and delve deeper into the electrical processes, which occur within the thundercloud.

It will be seen that a thunderstorm is something more than rain, wind, lightning, thunder and hail.

The production of electricity of whatever form involves the generation of positive and negative charges of equal quantities. Any generator operates by separating these opposite charges from each other.

Just as a generator which supplies our homes with electricity sends its positive and negative charges to their respective terminals so a thundercloud sends its opposing charges to the top and bottom of the cloud respectively.

It is now an accepted fact that the base of a thundercloud holds a negative charge and the top a positive charge.

GENERATOR

We can, therefore, look upon a thundercloud as a generator of electricity. In last month's story mention was made of the updraughts of air in the thundercloud, which bring about the electrification. But in many clouds there is more than one updraught and the cloud becomes a multiple generator because each separate updraught creates a negative base and positive top all in the one big cloud.

It is this phenomenon which

by Calvin Walters

this conducting channel by sending a streamer across from its negatively charged base to the top end of this conducting channel.

When this process is completed the next charged portion does likewise, and so on until the cloud is completely discharged.

The result is a series of separate discharges along the same path which gives rise to the flickering effect of the flash.

The separate charged portions of such a thundercloud are called cells, and it has been calculated that these cells in a three cell cloud are about four miles apart.

For a flash to discharge across this distance calls for forces of vast magnitude and such indeed they are.

The currents in a return streamer have been measured and found to be up to 200,000 amperes. This current discharges through a channel of air which is only about six inches in diameter.

IONISATION

As air normally is a very weak conductor of electricity, it is seen that a very great alteration must take place.

A molecule of air can become electrically charged or ionosed as it is called by losing or gaining an electron.

A small percentage of the molecules of the atmosphere become ionised by the impact of fast moving particles of cosmic rays and other

emanations from the earth such as radium particles.

For an electron to become an ionising electron it must be travelling at a certain critical speed of 90 miles per second. Those of cosmic rays are travelling at this speed, at least, consequently certain molecules of the atmosphere are ionised and our atmosphere becomes a very weak conductor. There are about 10,000 ions in every cubic centimetre of air. This a very weak combination, indeed, considering the millions upon millions of un-ionised molecules in the air.

Consider now the conditions in a thundercloud. Here a single negatively charged electron can be so strongly repulsed by the positive charge on the top of the cloud that it is given a speed far exceeding the critical speed for it to become an ionising electron.

This electron, by collision with another, creates an additional electron which, being in an accelerating electric field also becomes an ionising electron.

CHAIN REACTION

So a chain reaction goes on with the creation of new ionising electrons until from one single electron 24-million others are created in travelling a distance of one centimetre.

To carry the computation further, it has been estimated that about three million million million new ionising electrons are formed from a single one in travelling a distance of one inch.

We can now understand the tremendous forces which are built up within the thundercloud, and these forces would reach still greater proportions were it not for the lightning discharge.

It is this process of the formation of an avalanche of ionising electrons which starts off the lightning flash.

Immediately the conditions are created for the electron avalanche to break down the air in front, the "leader" begins to move downwards towards the earth. Its speed is anything from 60 to 90 miles per second.

On its downward journey the air which it penetrates is broken down, and so ionised that it contains a thousand million million ions in each cubic centimetre.

The channel formed by this process becomes an excellent conductor on the surface of which is carried up to half the charge originally held by the base of the cloud.

If we look upon this process as a lowering of the electricity in the cloud closer to the earth we can easily see what happens next.

STRONG FIELD

A very strong electric field is created between the leader and the earth. There then springs from the earth a positive streamer, which joins the end of the leader from fifteen to thirty feet above the ground, with a brilliant burst of flame. This is the beginning of the return stroke.

This return stroke is exceptionally fast and carries enormous force and violence. Its speed is much faster than that of the leader because the latter has already heavily ionised the path along which the return streamer travels.

On its upward journey, the return stroke passes on to the ground the electricity held by the leader, and finally the cloud is discharged to earth.

This then is the mechanism behind the lightning flash and to give some idea of the forces involved some figures would not be out of place.

Currents of 200,000 amperes have been measured, but the most frequent value is about 30,000 amperes in the return stroke.

The charging mechanism inside the cloud supplies about four amperes of current. This recharges the cloud in about 20 seconds.

The quantity of electricity discharged in a flash of lightning is about 20 coulombs. (coulomb is the quantity of electricity transferred by one ampere in one second.) Quantities of 100 coulombs have been registered.

The amount of energy dissipated in one flash of lightning to ground is about five thousand million calories.

This flaming streak of lightning hits a high spot of ground during a heavy storm.

If a cloud discharges and recharges every 20 seconds it dissipates electrical energy at a rate of one million continuous kilowatts. Approximately three-quarters of the energy of a lightning flash is used up in heating the surrounding air. In a few ten millionths of a second the temperature of the air is raised to as high as 15,000 degrees centigrade.

When this happens the air rapidly expands in an explosive manner and powerful sound waves are produced. This is thunder.

There are some characteristics of thunder which are worth notice.

A prominent feature is the rumbling of the sound. This is brought about by a variety of factors such as the separate strokes in each flash.

It is also caused by the different distances from the ear to different portions of the cloud. Specially loud thunder claps are usually caused by two different claps from different portions of the cloud arriving at the ear at the same time.

Echoes from the cloud base also cause the characteristic rumbling. The sound produced by the leader is weaker than that produced by the return stroke and has a frequency of from 10,000 to 30,000 cycles per second. It has been likened to the tearing of calico.

The distance away of a lightning flash may be calculated by counting the seconds from the time of the flash to the sound of the thunder. Every five seconds counted represents one mile of travel.

According to the meteorologist Brookes about 16-million thunderstorms occur over the earth in the course of a year. This is an average of 44,000 storms a day or 1800 storms every moment of the day with each storm giving out lightning flashes at such a rate that the total number of lightning flashes in any one second is 100.

It is little wonder then that it has been assumed that these storms have something to do with the maintenance of the permanent electric charge existing on the surface of the earth.

During the time a thundercloud is overhead every tree and projecting point of buildings discharges electricity into the air between them and the thundercloud.

500 AMPERES

Measurements have shown that the total current passed upwards in a wooded area can be as much as four or five amperes or about the same as the generating current within the cloud itself.

If the thundercloud is regarded as a generator it means that the cloud is connected through an external circuit to the earth and upper air and the air below.

The result is that the heavily negatively charged base of the cloud is all the time drawing positive charges from the earth thus leaving a negative charge behind in the earth.

On the other hand the positively charged top of the cloud draws negative electrons from the air above, thus leaving a net positive charge behind.

The rapid spread of these charges all over the earth and in the air above maintains a balanced condition particularly in regions of fine weather.

To support the theory it has been pointed out by Professor C. T. R. Wilson that without a continuous recharging process the low conductivity of the earth would be good enough to pass a current which would neutralise the two sets of charges in about ten minutes. (Schonland).

Space does not permit further discussion of this most interesting subject. We hope, however, that now we have proved Gilbert and Sullivan to be slightly in error, we have stimulated your interest in that commonplace phenomenon the thunderstorm.

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Technical Review

A WIDE-RANGE VARIABLE CAPACITANCE PICKUP

In a recent issue of Radio and Television News, Paul Weathers describes the construction of a variable capacitance pickup, from which an outstanding performance is claimed.

THE writer points out that the idea of a variable capacitance pickup is by no means new, but it has largely been neglected in favor of pickups which are more easily coupled to an amplifier.

It did appear, nevertheless, that the variable capacitance principle had much to commend it in a "fidelity-first" design, because the stylus needed only to vibrate without performing additional physical work to generate the output emf. This suggested the possibility of extremely low mass and high compliance, while keeping bass and treble resonance effects outside the audible range.

The chief problem encountered was that the variation in capacitance between the moving stylus and a fixed plate was inherently non-linear.

The effect could be minimised by maintaining a wide spacing between stylus and plate, but only at the cost of sensitivity. Push-pull capacitance variation offered another solution, but its application was likewise inconvenient.

EARLY FAILING

A final failing of earlier capacitance pickups was microphony in the output lead, since variation in lead capacitance would produce a signal.

The type of output coupling and oscillator circuit evolved by the writer eliminates all disadvantages at one stroke.

The active lead from the stylus is rigidly supported within the hollow arm of the pickup and runs directly to a 16 Mc. coil attached to the base end of the arm. (See L1 in the circuit). The flexible output lead is tapped down the coil and is effectively at a much lower impedance.

The first triode V1a operates as a tuned-plate tuned-grid oscillator, L2 being adjusted by means of its core to a higher frequency than L1.

In operation, V1a oscillates continuously, but its frequency and amplitude is modulated by the variations in the pickup capacitance. At the same time a rectified audio component appears across the plate load resistor R1 and this is coupled to the grid of the second triode V1b.

Audio signals appearing in the plate circuit of the second triode achieve a peak amplitude of 5 or more volts, while bypass and feedback circuits operating around the stage produce the necessary compensation.

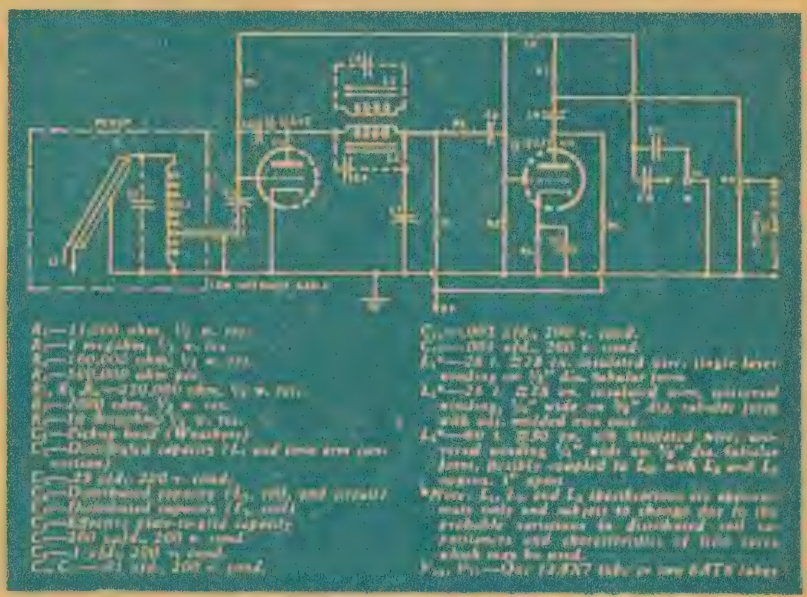

Figure 1. The circuit for producing linear response from a single-sided capacitance unit.

Figure 2. Frequency response of the Weathers phonograph pickup system. Waveform is also excellent.

Coil L3 is added as a refinement, being loosely coupled to L2, and resonated at a lower frequency than L1. The variations in oscillator behavior can be traced primarily to the variation of C1, but L3 and the Miller effect in the tube also operate to increase the signal output.

Compensation for the non-linear capacitance variation of C1 is achieved by suitably adjusting the operating point on the oscillators amplitude versus frequency curve. The two non-linear functions can be made to cancel almost exactly.

For the stylus, a tubular shank was chosen and a sapphire tip, diamond being reckoned unnecessary because of the favorable tracking characteristics. The arm was fashioned from ¼in tubular aluminium and resonated with the stylus compliance at 20 cps. Treble resonance was at 17 kc.

Without additional counterbalancing, pressure on the stylus point was measured at 5 grams, under which condition the pickup would not jump grooves, even when the turntable was heavily bumped.

With counterbalancing, operating pressures of as low as 1 gram could he achieved, still with excellent tracking.

Ultimately the counterweight was discarded in favor of a light brush which rides ahead of the stylus point and prevents dust particles from prdoucing the familiar clicks on microgroove recordings. The brush also reduced the weight on the stylus point.

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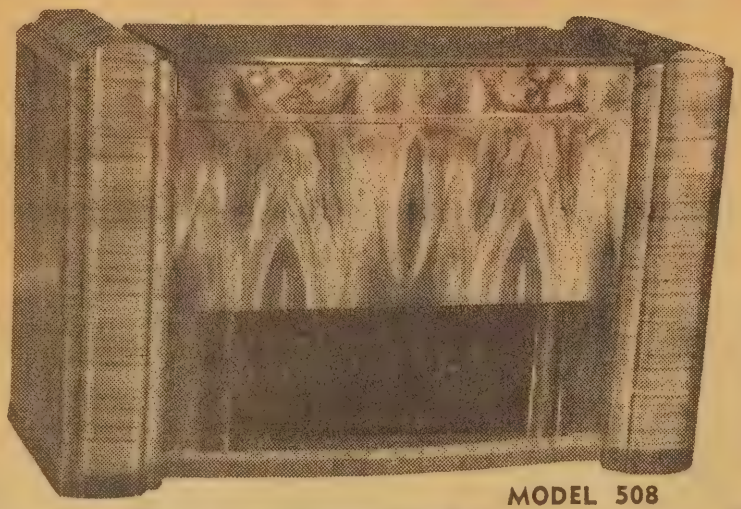

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MODEL 508

Model 508 is suitable for all types of record changers.

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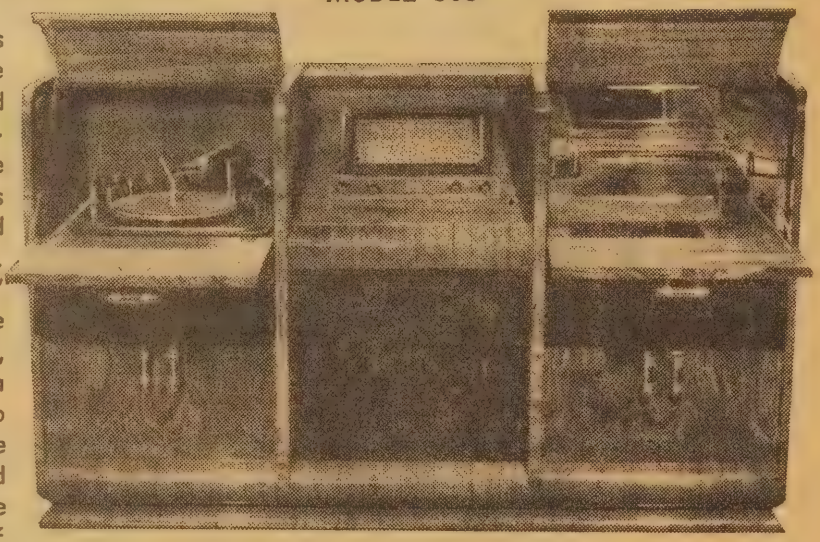

MODEL 511

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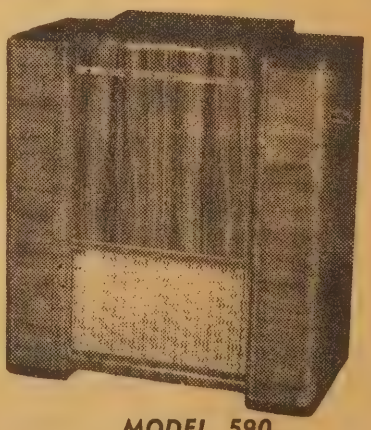
Model 509 is suitable for single motors. Dial fits on front of cabinet, lid being lifted only for record playing.

High fidelity custom built 5 valve D.W. chassis specially built for microgroove or tape recording. Price with 12" Rola speaker £28/10/0 Nett. One Garrard RC65 or RC70A, Collaro or Palliard record changer with each unit.



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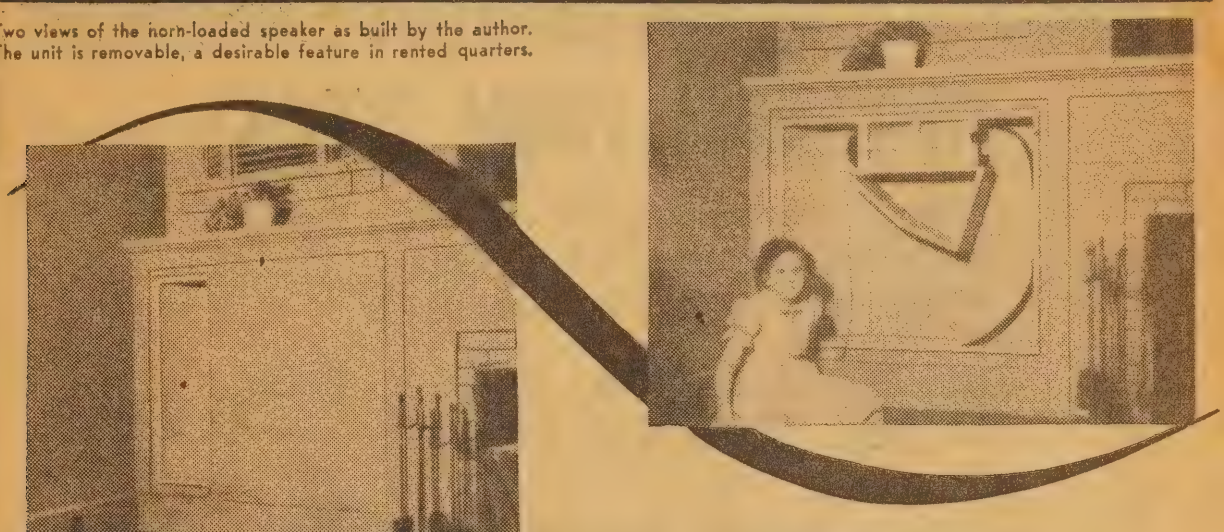
USEFUL IDEA FOR HORN-LOADED LOUDSPEAKER

Two views of the horn-loaded speaker as built by the author. The unit is removable, a desirable feature in rented quarters.



Although this speaker horn was designed for a WE 755-A speaker or similar type, it should work quite well with ordinary speakers, using the horn to load the back. It requires very little carpentering skill and uses easy-to-get materials.

FOR those who have a fireplace-bookcase combination of this type, it is an easy task to build this inconspicuous unit. Add a horn to your present speaker to provide smoother performance. It will extend the unit's low frequency response considerably.

As most of you know by now, there is no substitute for a horn for true sound reproduction. The corner horn has been developed to achieve the necessary heroic dimensions while providing something you can stuff in your living-room.

I had to be convinced of the value of a corner horn, but after listening to two of them, the convincing was done. All I had to do was find a corner to put one in. We recently moved, and one of the things I looked for in our house-hunting was a corner in which to put a speaker. Houses aren't usually built with such specifications in mind so we had to settle on a house that met our other requirements.

We now had a house that was unsuited for a conventional corner type horn, and in addition, we didn't have the money to spend on the high-priced woofer and tweeters for a two or three channel system.

We did have a fireplace at one end of our living-room with bookshelves on each side that extended to the corners and we also had a very fine eight-inch speaker. A little plywood, a little linoleum, a little imagination, and a lot of work, and there was our corner horn.

It probably isn't the master, or even the equal, of the more elaborate jobs but it provides substantial improvement for an already fine speaker. Horn loading smooths and greatly extends the bass response. High frequency dispersion is accomplished by reflection from the curved, vertical piece of linoleum. As shown in the photograph, the high frequency source is above chair height, so furniture arrangement is quite independent of sound considerations.

Room appearance and flexibility of furniture arrangement were important considerations in designing this system. It was decided that a compromise in sound quality would be more desirable than a perfect sounding, obnoxious looking, bulky contraption.

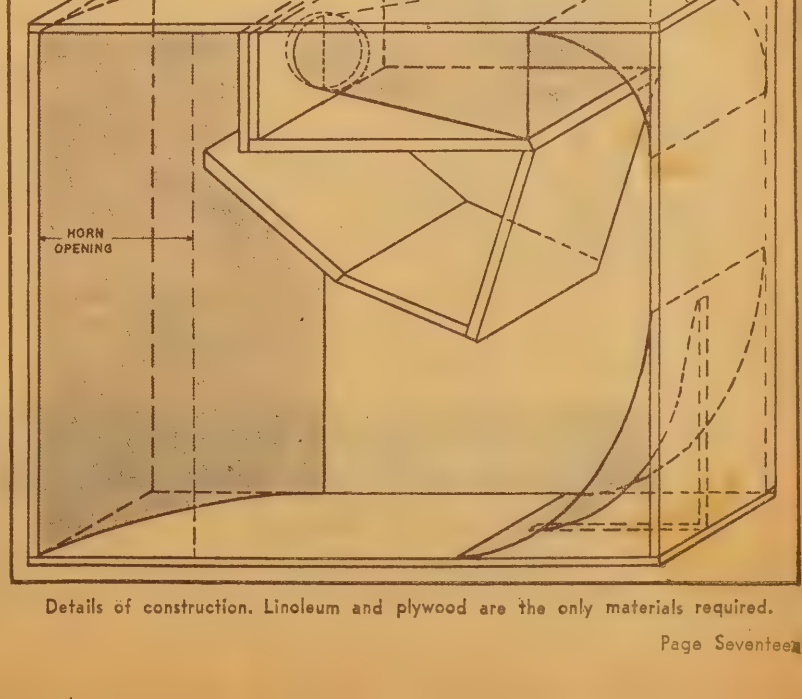
Of course, the "Better Half" had some influence in that decision!

In this design, most of the construction errors are hidden. As it turned out, there wasn't much compromise. It is a source of considerable satisfaction to have other high-fidelity enthusiasts listen to it, then start figuring how they can build one like it.

The horn is made as a unit in a box. It slips in the opening where the shelves are slipped out. Thus restoration of the original bookshelves is a simple matter when we move an item that deserves consideration.

Actual construction is really quite simple. Being anything but a master wood craftsman, it won't be hard to improve on my model. The size of the available opening in which the assembly is to be built will determine the length of horn which can be enclosed. That in turn will determine the rate of opening.

(Continued on Page 19)



Details of construction. Linoleum and plywood are the only materials required.

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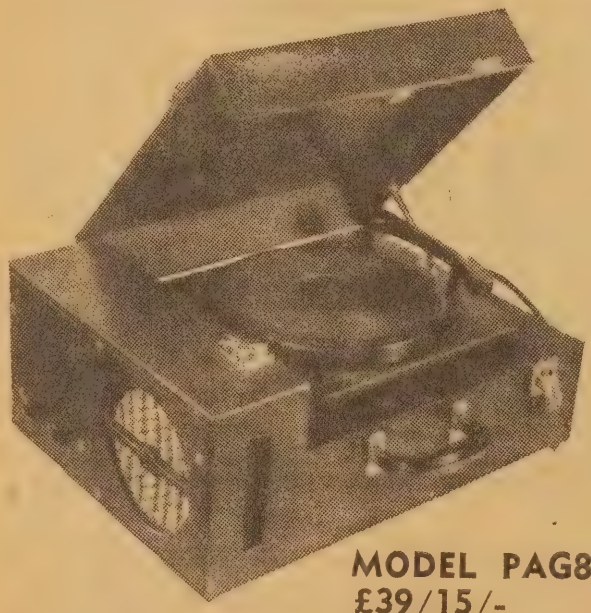

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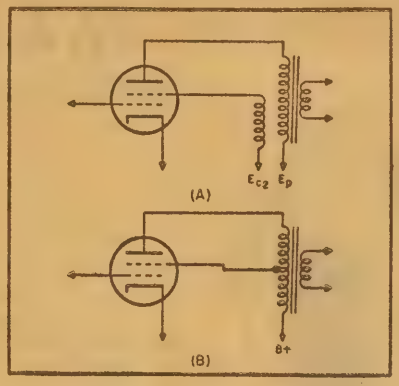
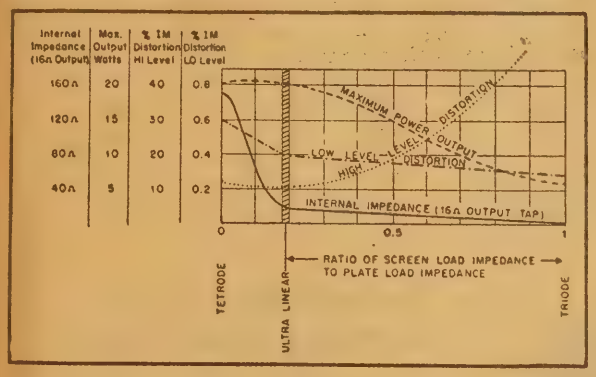
NEW CIRCUIT GIVES "ULTRA LINEAR" AMPLIFIER

Research into the comparative merits of tetrodes and triodes as audio power amplifiers has produced yet another circuit which allegedly combines the good features of both. It is described by Hafler and Keroes in "Audio Engineering."

AS is well known, the outstanding advantage of the tetrode is its high plate efficiency and its consequent ability to deliver greater power output before overload, for a power supply of given rating. A triode, on the other hand, while suffering reduced power output, gives lower distortion at moderate levels and better damping of the speaker cone.

Considering the familiar problem, the authors of the article in question reckoned that, since the difference was traceable directly to the screen grid interesting things might happen if the screen was made to partially share the load circuit along with the plate. In other words, with a tetrode, the screen is returned to the B-plus end of the load while it is connected directly to plate for triode operation.





(A) Illustrated above are two methods by which the screen can be coupled partially to the output load, (B) is the preferred method and requires five connections to a push-pull primary winding. On the left are shown curves which depict the transition from tetrode to triode operation.

What would happen if the screen were tapped part way along the load?

Investigation produced a set of highly interesting curves which show the various operating characteristics plotted against the screen tapping position on the load.

It was found, for example, that the effective output impedance dropped rapidly till it approached the figure for triode connection when the screen was tapped up only 0.2 of the way (in terms of impedance) from the B-plus end.

HIGH OUTPUT

At the same time, the maximum power output and the consequent overload distortion at peak levels did not show any deterioration from the abilities of the tetrode in this respect. The low-level distortion, however, dropped sharply to approach the commendable figures achieved with a triode.

In other words, by tapping the screen at a point approximately 0.2 from the B-plus end, or by using a suitable multiple-wound transformer to give the same effect, the output stage produced the high efficiency and output of tetrodes, together with the low distortion and good regulation of triodes.

It is pointed out that the circuit does not in any way prejudice the use of negative feedback, if this should be required, to improve further the characteristics of the amplifier as a whole.

A typical amplifier circuit suggested by Hafler and Keroes uses a twin triode as amplifier and phase inverter, push-pull triode drivers and a pair of 6L6's in the output stage. Feedback is taken from the output transformer secondary back to the first cathode, in the current fashion.

A maximum power output is claimed of 24 watts under the particular input conditions, this figure being sustained and measurable between the limits of approximately 30 and 15,000 cps. The frequency response below the overload region is within 1db from 1½ to just under 200,000 cps.

EXCELLENT FIGURES

Intermodulation distortion rises in linear fashion to 1½ pc at 20 watts, curving upward thereafter as the output stage approaches overload.

On square-wave tests, according to the published data, the output was completely rectangular at 20 cps. and developed only the slightest roughness at 10 Kc. Even at 30 Kc the wave is showing only a small departure from the ideal shape.

Listening tests are claimed to favor this amplifier against other unspecified high quality units. The reasons advanced include the complete stability of the amplifier, even at very low frequencies and the very low intermodulation distortion which is encountered at listening levels.

BY WAY OF COMMENT,

While the authors have apparently taken care with the choice of operating conditions for the 6L6 valves, much additional investigation would be necessary to see how closely the results are duplicated in other tetrodes or pentodes. In the meantime they appear to have derived a very interesting circuit arrangement.

The chief difficulty in its application would be in obtaining an output transformer having the primary tapped at a convenient point.

IDEA FOR HORN-LOADED LOUD SPEAKER

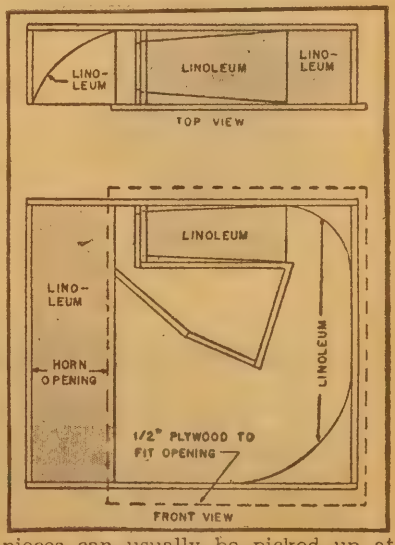
(Continued from Page 17).

In my case, the cross section area was doubled every two feet. This provides loading to 32 cycles. Intermediate cross sections were gauged by eye, and some improvement could probably be made by expending more effort to get more accuracy.

For example, the basic unit could be divided by 3, then the rate of opening would be as follows:

Units of length.	Multiplication cross-section area.
1	1.26
2	1.59
3	2.00
4	2.51
5	3.16
6	3.98
7	5.01
8	6.31
9	7.94
10	10.00

Considerable care should be used in forming the curves of linoleum to insure good results. If this is not done, very objectionable reflections will occur and the results will be poor. Linoleum was chosen to form the curves because it is inexpensive, easily worked, and quite inert. Scrap pieces can usually be picked up at a furniture store at very low cost.



—Radio and Television News.

The WARBURTON FRANKI Page

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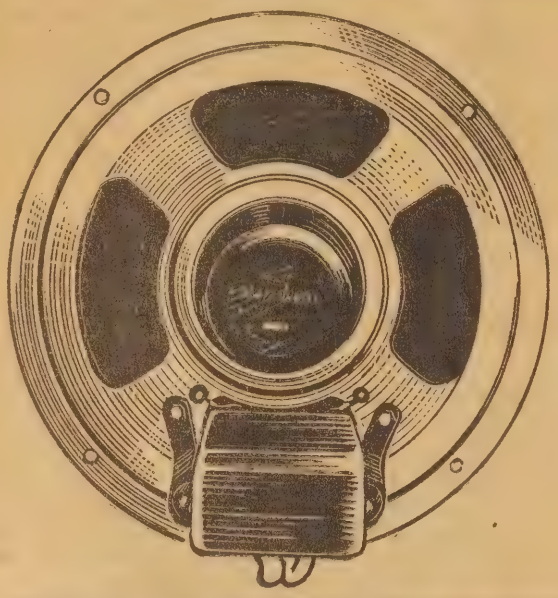

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Model 8P2	**65/8**	Model 12P1	**92/7**
Model 8P1	**72/-**	14/60 Filter Chokes	**13/11**

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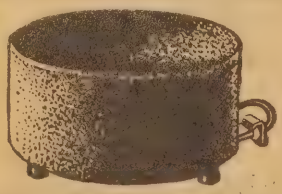

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NEWS AND VIEWS OF THE MONTH

Amateur Records

AUSTRALIAN amateurs have had plenty of activity on the 50 mc band during the last two months. As usual at this time of the year, propagation conditions have allowed communication over a considerably wider area than is normal.

Interstate contacts have been an almost daily occurrence since the end of November last year, the band at times being "open" for days on end.

This season, contacts seem to have been made more consistently over longer distances than usual. Amateurs in Perth and in New Zealand have had many good exchanges, and at times it seemed that every State was able to work every other State and New Zealand as well, if not at exactly the same time, at least within an hour or two. It was quite common for a station to perform this feat half a dozen times during the eight weeks. VK9XK in Samarai (NG) was successful with many stations in Australia and New Zealand.

More interesting this season has been the success with long distance contacts on the 144 mc band. As reported elsewhere, VK2AH contacted ZL3AR, and VK6BO contacted VK5GL on this band, and others heard signals over comparable distances.

It might be true that, with such obviously favorable conditions, only patience was necessary to make such contacts. But behind the patience one must have good equipment and a great deal of enthusiasm. Both distances are only a short distance under the world record for communication on this band, and the feats have helped enormously to counteract the view that the VHF bands are useful only for talking over the back fence.

The Ross Hull Contest for long distance communication on 50 mc, was particularly successful this season. It was much less of a scramble than it has been, with a little more conversation per contact than the mere exchange of numbers.

If we are to find more 144 mc contacts occurring during the period of the contest, the contest committee might well consider extending the scoring to include this band. It would certainly add to the value of the contest, and throw great stress on the higher frequencies.

Salt Saves Millions

AN interesting scientific report during the month concerns the use of a capsule of common salt to check a fault in a machine which otherwise would have failed involving a loss of jet aircraft parts worth £3-million.

The salt was worth only 100 dollars, yet, it prevented a probable 12-month shutdown of a giant extrusion press in the Aluminim Company of Canada's plant in Ontario.

This press produces 250,000lb of jet parts a month.

The emergency came when a fracture developed in the foot-thick steel wall of a cylinder.

It was simple enough to weld the visible crack, but what worried officials was whether the cylinder had developed any internal cracks.

If it had there was little chance it would continue to operate very long.

To get a new one meant a 12 to 14 months wait.

Looking for a way to photograph through a foot of steel, plant officials called on a team of scientists.

First they took eight grams of sodium fluoride.

POPULAR SCIENCE QUIZ

Q. What is the difference in meaning between the terms "heat" and "temperature"?

A.: When correctly used, these two terms are separate entities. The subtle difference can be illustrated by noting that a lighted match may have sufficiently high flame temperature to set alight to a piece of paper or to burn one's hand but has insufficient "quantity of heat" or "heat content" to melt an ice cube. In contrast, a domestic sink half full of warm water contains sufficient quantity of heat to turn the ice cube from its solid state to the liquid state.

We know that temperature is measured with a thermometer, a device which indicates on a standard scale the expansion of a liquid following the introduction to it of a small quantity of heat. The point is however, that a thermometer indicates the temperature of a body or substance but not the quantity of heat contained in it.

The quantity of heat in a body is measured in such international units as the Calorie and British Thermal Unit. The former refers to the quantity of heat necessary to raise the temperature of 1 gram of water through 1 degree Centigrade while the latter has to do with the heat necessary to raise the temperature of 1 pound of water through 1 Fahrenheit degree. One British Thermal Unit (B.T.U.) is equal to 252 Calories.

Q. What is "dry ice"?

A.: The substance referred to as "dry ice" is actually frozen carbon dioxide. When carbon dioxide is reduced in temperature, it reaches its solid form at a point in the temperature range some 78 degrees Centigrade below that where water turns into its solid form (ice).

This means that for equal volumes of "dry ice" and ordinary ice, the former is capable of absorbing much more heat before it turns into its original form, that is, a gaseous state. This important feature is utilised in the transportation of perishable goods, a familiar illustration of which is an ice-cream delivery truck.

The supposed "steam" which can be observed rising from a piece of "dry ice" is not transformation of the carbon dioxide from its solid form into the gaseous form but merely the reaching of the dew point of the air immediately surrounding it. This is more evident with "dry ice" than with ordinary ice because of its much lower temperature.

The actual transformation from the solid to the gaseous form of carbon dioxide is noticeable only by the diminution in size of the original piece. On the change to the gaseous state the carbon dioxide disperses in the surrounding atmosphere leaving no trace. Other features are cleanliness and lack of odor.

Q. We hear of water-pipes bursting in extremely cold weather. Why is this?

A.: Whereas most substances have a more or less regular variation of density with change in temperature, water has, in common with such substances as bismuth, iron and antimony, a rather irregular variation.

A given mass of water will have maximum density when its temperature is at 4 degrees Centigrade (about 39 degrees Fahrenheit). This means that while its density decreases with increase of temperature above this figure, a reduction in temperature to zero degrees C also brings about a decrease in density. Furthermore, when this mass of water gives out its latent heat of fusion to become ice at zero degrees C, it suffers a further decrease in density.

This can be readily appreciated from the fact that an iceberg floats with part of its mass protruding above the water-line, indicating that although the amount of water displaced weighs the same as the iceberg, its density is greater.

To apply this reasoning to the "burst water-pipe" problem, it is necessary only to realise that if a given mass of water suffers a decrease in density, its volume must increase in the same ratio. Enormous pressures can be exerted by water as a result of this. When water is in the process of freezing solid, its ability to flow back out of a pipe is reduced and where a water-pipe is in a weakened condition due to oxidisation (rust), the result is obvious.

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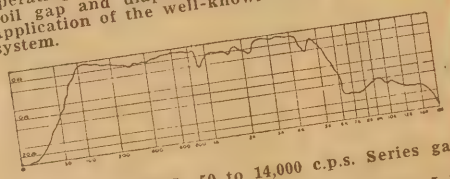
Stentorian Concentric DUPLEX SPEAKERS

10 INCH

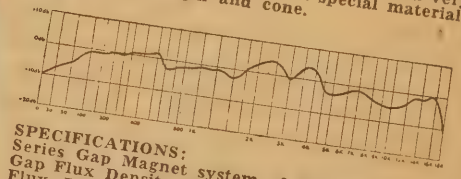
The most advanced and efficient "twin" quality speaker available for domestic use. The concentric Duplex speaker constitutes two separate loudspeakers, concentrically mounted . . . each operating independently with its own speech coil gap and diaphragm, embodying the latest application of the well-known series gap magnet system.



SPECIFICATIONS: 50 to 14,000 c.p.s. Series gap Magnet of Alcomax 3.
Flux in L.F. gap, 12,000 gauss on 1" pole. L.F. diaphragm of multi-fibre material, graduated cone formation 10" diameter. L.F. speech-coil impedance, 3 ohms at 1000 c.p.s.
Flux in H.F. gap 13,000 gauss on 1" pole. H.F. metal diaphragm, convex formation 1" diameter, mechanically protected and loaded by non-resonant central pressure horn.
H.F. speech-coil impedance, 30 ohms at 1000 c.p.s.
Power handling capacity (both component speakers) 6 watts.
Chassis material, pressure die-cast from Mazak 3, non-magnetic and non-resonant alloy.

12 INCH

This quality loudspeaker is of similar construction to our highly successful 10" Concentric Duplex Loudspeaker and combines exceptional quality with large power handling capacity. This is achieved by the use of a very high flux density magnet and special materials for the diaphragm and cone.



SPECIFICATIONS:
Series Gap Magnet system of Alcomaz 3. L.F. Gap Flux Density of 14,000 oersteds. H. F. Gap Flux Density of 17,000 oersteds. Total Magnetic Flux 220,000 lines. L.F. Speech-coil impedance, 15 ohms at 1000 c.p.s.
H.F. Speech-coil impedance, 15 ohms at 1,000 c.p.s.

L.F. Diaphragm of multi-fibre material, graduated cone formation, 12" diameter. H.F. metal diaphragm, convex formation 1¾" diameter, mechanically protected and loaded by non-resonant central pressure horn. Cross-over network, with input impedance of 15 ohms, fitted to loudspeaker chassis. Chassis material, pressure die-cast from Maxak 3 non-magnetic and non-resonant alloy. Frequency coverage 30—17,000 c.p.s. with Base resonance at 45 c.p.s. Power handling capacity — 15 watts.

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It was sent to Chalk River and baked in the atomic pile until it became radioactive.

The capsule of salt was then slipped into a giant lead case weighing a ton and rushed several hundred miles to Kingston.

The salt had a radio-active life of about only 14 hours.

Things had to be done quickly.

When the huge lead block arrived at the aluminium plant atomic experts lifted the radio-active capsule from the container with an electro-magnet attached to a crane.

In less than a minute the pinch of salt was swung into the upended cylinder of the press, which had been already wrapped with X-ray film.

FLAW FOUND

All night the scientists worked, putting new film around the cylinder and developing their exposed ones.

Next day they had their reward. Gamma rays given off by the radioactive salt had traced on the film the shadowy line of a flaw deep inside the cylinder wall.

For the first time in history man had "looked" through a foot of steel.

Knowledge gained took the uncertainty out of the company's operations.

Engineers, guided by their visible diagnosis, are working swiftly to rebuild the cylinder, knowing that once it is repaired it will be good for a long time.

★ ★ ★

SARNOFF'S 45 YEARS

DAVID SARNOFF, chairman of the board of the Radio Corporation of America, has celebrated his 45th year in radio. For his 50th anniversary he has named three things he would like to see produced by RCA.

One is an electronic amplifier of light, which would provide brighter pictures for television, allowing projection in the home or the theatre to any size and degree of brightness. It would in fact be to television what the loud speaker has been to radio. At the moment, projection schemes must make the best they can of the original amount of light produced by the television screen.

The second is a television picture recorder, which would allow television programmes to be recorded and reproduced just as sounds are now recorded on records or on tape and reproduced on gramophones.

The present system of film television he thinks is too costly, time consuming, and limited. But the new television recorder would be just as simple as a gramophone record, and just as flexible in its use. (Note —Dr. Zworykin made references to this possibility several times when in Australia recently).

The third development wanted for Sarnoff's 50th anniversary is an electronic air-conditioner for the home which will operate noiselessly and without moving parts. He visualised the possible use of electrons movement in solids rather than conventional electron valves.

Mr. Sarnoff revealed that RCA has been successful in deriving electric voltages from radio-active materials, an achievement in its initial stages, but possessing enormous possibilities, particularly as future sources of power and its application to electronics.

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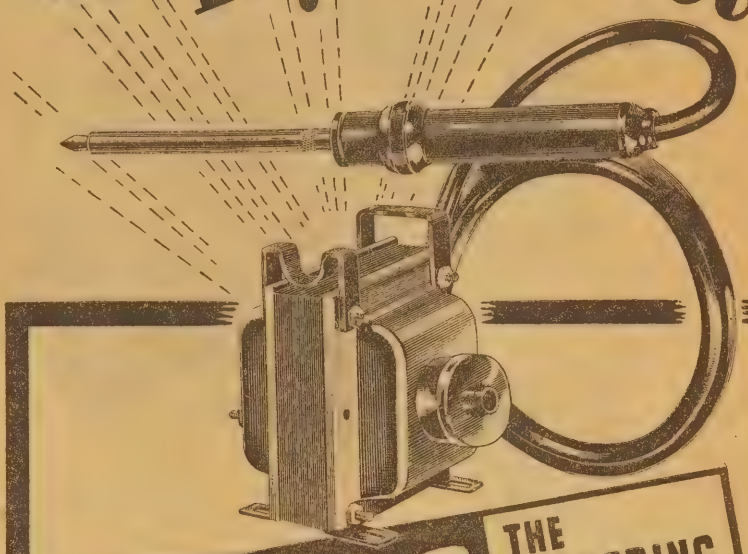

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Weighs only 3½oz. Measures 10in long.
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This long-life Scope is fully guaranteed for three months from date of purchase.
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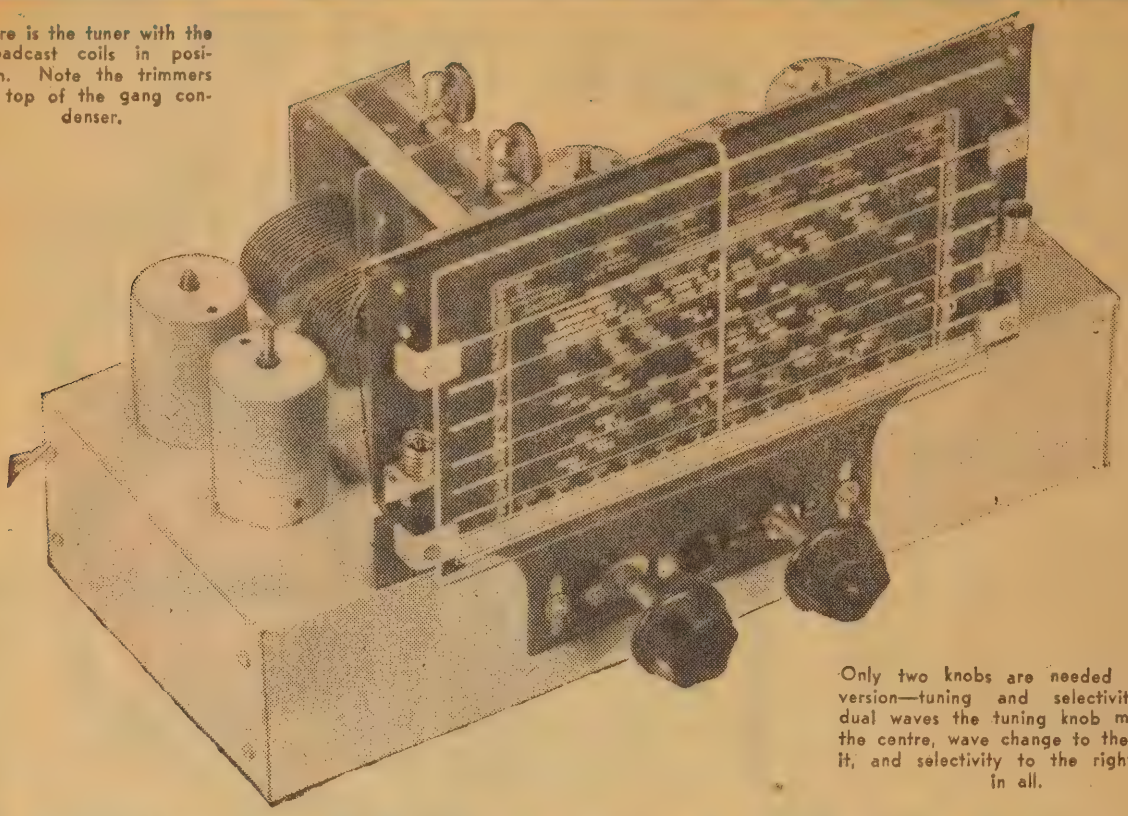


Here is the tuner with the broadcast coils in position. Note the trimmers on top of the gang condenser.

Only two knobs are needed for this version—tuning and selectivity. For dual waves the tuning knob moves to the centre, wave change to the left of it, and selectivity to the right—three in all.

THE PLAYMASTER TUNER No. 1

Having completed the series of PLAYMASTER amplifiers, and a couple of control units to go with them, we come now to the tuners. This month's tuner is a superhet which may be built either for straight broadcast reception or for dual waves.

by John Moyle

THE description of the tuners is in line with the unit construction of the PLAYMASTERS.

In order to present tone compensation and control facilities to match modern requirements, you will remember that the amplifiers were split into two units. One of these was the amplifier proper with a sensitivity of about half a volt, and the other a control unit, including a pre-amplifier which stepped up the gain about five times.

CONTROL UNITS

This pre-amplifier provided the tone compensation circuits already mentioned. These gave automatic compensation for 78 records, both British and American, as well as for long-playing records. The same switch made available a radio position, and a microphone position which, however, will probably be used only in a few special cases.

The separate control units add greater flexibility to the system, for they may be mounted independently of the main amplifier on the motor board or front panel of a cabinet. They can be mounted directly to the amplifier chassis if required, thus converting the two units into one physical unit. Isolation of the important circuits allows hum level to be reduced to a negligible level by avoiding earth loops in the high gain stages.

This unit construction and tone compensation are a necessity for use with modern lightweight pickups, and will become even more so in the future.

The amplifiers consisted of the PLAYMASTER SENIOR (No. 1), which used a pair of 807 valves with an output of over 20 watts. The PLAYMASTER (No. 2), using a similar circuit with a pair of 6V6's in the output stage giving about 12 watts, and the PLAYMASTER JUNIOR (No. 3), the low powered member of the family, with an output of about 4 watts.

All these amplifiers may be used with either CONTROL UNIT No. 1 or No. 2. The first was a simple job with a volume control and selector switch. The second was a more elaborate version which added extra bass and treble controls to the volume control and selector switch.

This short review will bring the PLAYMASTER position up to date, and clear the way for a discussion of the tuner problem.

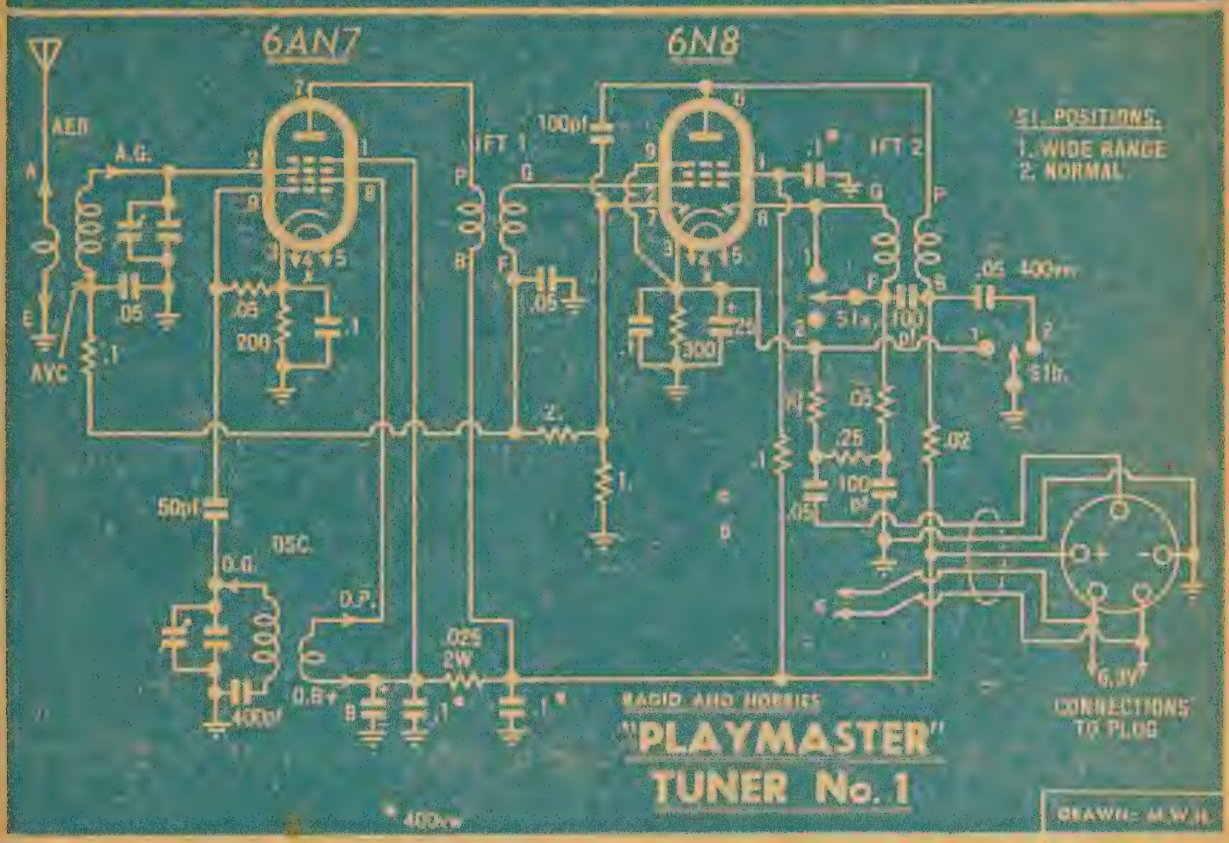
Obviously, a high grade audio system is valuable for radio reception as well as record playing, particularly as the outlay to date should be made to give the maximum return. So far we have radio input sockets already wired to both control units, but nothing as yet to plug into them.

EARTH LOOPS

The tuning units connect to the control units mainly because that is the logical position, remembering that the output from the tuner is required to pick up some of the tone compensation facilities, at least in the UNIT No. 2, and in any case must pass through the volume control.

Just as important is the avoidance of earth or ground loops, which tend to couple hum voltages into low-level stages. There must, therefore, be no common earth wire between the tuner and either of the other units, apart from the connec-

CIRCUIT DIAGRAM FOR PLAYMASTER TUNER No. 1



The circuit is unchanged for either broadcast or short wave versions. Addition of the whistle filter if used is shown on a separate diagram on page 29.

tions normally made through the interconnecting cables.

If an earth wire is used for the installation, it may be made to either of the units—normally the main amplifier—but not to more than one.

Having decided to build the tuner as a separate unit, there is no reason why we should not build any kind of tuner we desire. The problem in completing the series was to decide which kind of tuners would most likely be desired by builders of PLAYMASTER equipment.

Obviously, there is a definite need for a wide range, local station type of tuner, which will give as wide a frequency response as possible. This is to minimise the side-band cutting which is so characteristic of a superhet circuit.

SUPERHET TUNERS

To date we have generally used a TRF circuit for such tuners, because it is quite the simplest way of obtaining a wide bandwidth. It is also so cheap and easy to make that such a tuner is an automatic choice.

Many builders, however, will want to use their amplifiers with a superhet. tuner with normal selectivity, and the extra gain characteristic of the superhet. circuit.

A tuner of this type is rather a satisfying kind of thing to make because, with a little care, it can be laid out in such a way as to allow a number of variations to be made without great trouble.

This is the type of tuner we have selected for this issue, and a more detailed discussion of these variations will be made later on.

PARTS LIST

1 chassis 12½in by 5½in by 2½in.
1 4/5 D/W coil unit or 2 broadcast coils, aerial and osc. (suit 6AN7 valve or similar).
1 2-section gang tuning capacitor
1 dial with glass to suit (USL32 or similar).
2 455 kc IF transformers (Nos. 1 and 2).
1 2-pole, 2-position wafer switch.
2 gang trimming capacitors (for broadcast version).
2 9-pin miniature sockets, 1 5-pin plug with cover.
1 6AN7, 1 6N8. VALVES

RESISTORS

1 2 meg., 1 1 meg., 2 .25 meg., 2 .1 meg., 2 .05 meg., 1 .025 meg. 2 watt (or 2 .05 meg. 1 watt in parallel), 1 .02 meg., 1 300 ohm, 1 200 ohm.

CAPACITORS

1 25 mfd 40PV electro, 1 8 mfd 525PV electro, 3 .1 mfd 400VW, 2 .1 mfd 200 VW, 1 .05 mfd 400VW, 3 .05 mfd 200VW, 1 400pf mica low tolerance (for broadcast version), 3 100pf mica, 1 50pf mica.

SUNDRIES

3 knobs, 2 terminals (1 red, 1 black), 1 shaft coupling, a few inches of ¼in extension shaft, 1 5-tag and 12-tag mounting strip, scrap aluminium for coil unit mounting, 2 to 3 feet shielded hook-up wire, 1 rubber grommet, solder, solder lugs, hook-up wire, nuts, bolts, etc.

A third type of tuner would be one of the larger superhet. variety, using a coil box with an RF stage, and giving a performance equal to that of the largest radiograms. A big tuner of this nature might well feature variable selectivity to allow a near-perfect band-pass characteristic.

Whether we will be able to build such a tuner so that it can be duplicated easily isn't clear at the moment. There isn't much difficulty in building the big dual-wave tuner with an RF stage, or a tuner using one of the more elaborate (but expensive) coil units for that matter. But it isn't so easy to incorporate at the same time a really wide-range IF circuit which will appreciably outperform the simple resistance switching method features in the ADVANCE 1952 sets, and also in the tuner described herewith.

THIS MONTH'S CIRCUIT

At any rate, these are the types of tuners with which we have experimented to date, and all of which work very well indeed with the various amplifiers in the series. This month's No. 1 tuner is likely to be the most popular, and without further delay we will proceed to describe how to make it.

This tuner is essentially the same as the tuning end of the 1952 ADVANCE for the simple reason that we require the same service of it.

Essentially it is a tuner using two valves—a frequency converter and an IF amplifier, the latter with diodes which are employed for detection and AVC voltage in the nor-

"Q-PLUS"
RC 1
MIDGET B/C R.F COIL
"SPHEROCLAD" CONSTRUCTION

FREQ. COVERAGE—520—1600 Kcs.
TUNING CAPACITY — 25—445 uufd. (Inc. strays)
PHYSICAL SIZE—¾" x ¾" x 1⅜"
PIN CONNECTIONS—
P=Plate.
B+=B+.
F=Earth—secondary.
G=Grid

MOUNTING—3/16" whit nut onto moulded insert in base-template supplied.
PRIMARY INDUCTANCE—8.5 mH.
SECONDARY INDUCTANCE when tuned to 1000 Kcs.—210 uH.
APPROXIMATE GAIN at 600 Kcs.—12 times.
SECONDARY "Q" at 600 Kcs.—110.

REMARKS

Construction is of 9/41 litz wound secondary with primary designed for optimum RF coupling. Coupling of approximately .2 is maintained by gauged fibre washers. Top coupling is not included but may be added externally by means of about a 5-8 uufd. condenser between P & G terminals.

Earthing of can is accomplished by folded can lugs; care should be taken to see that sprayed chassis are cleaned at these points before assembling.

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"Q-PLUS"
RC 2
MIDGET B/C CAR TYPE R.F. COIL
"SPHEROCLAD CONSTRUCTION"

FREQ. COVERAGE—520—1600
TUNING CAPACITY — 25—445 uufd. (Inc. strays)
PHYSICAL SIZE—¾" x ¾" x 1⅜".
PIN CONNECTIONS—
P=Plate
B+=B+.
F=Secondary Earth.
G=Grid
A2=Secondary Tap.

MOUNTING—3/16" whit nut onto moulded insert in base-template supplied.
PRIMARY INDUCTANCE—2.5 mH.
SECONDARY INDUCTANCE at 1000 Kcs.—210 uH.
APPROXIMATE GAIN at 600 Kcs.—8 times.
SECONDARY "Q" at 600 Kcs.—110.

REMARKS

Construction is of 9/41 litz wound secondary with primary designed to give optimum coupling and correct alignment when used with AC2. Hi Secondary Q is obtained by use of Carbonyl Iron Dust Cups. Secondary is tapped and it is recommended that a 100 uufd. condenser be placed between P & A2 to complete correct coupling. Earthing etc. (see AC1).

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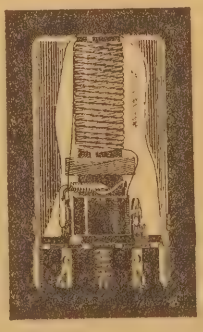
"Q-PLUS"
RC 4
Standard General Purpose B/C R.F. Coil



FREQ. COVERAGE—520—1600 Kcs.
TUNING CAPACITY—25—445 uufd. (includes strays)
PHYSICAL SIZE—1⅜" diam. x 2¼".
PIN CONNECTIONS
1—Grid.
3—AVC.
4—Plate.
6—B+.

MOUNTING—2 x ⅛" holes, 1⅜" apart.
PRIMARY INDUCTANCE—8.5 mH.
SECONDARY INDUCTANCE when tuned to 1000 Kcs.—210 uH.
APPROXIMATE GAIN at 600 Kcs.—12 times.
SECONDARY "Q" at 600 Kcs.—110.

REMARKS

This unit is of the progressively wound type 7/41 litz wire is used and a moderately high gain and "Q" is achieved. It is a good general purpose unit when high gain is not called for. Has inbuilt top coupling condenser

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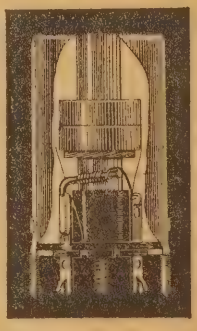
"Q-PLUS"
RC 5
STANDARD B/C R.F. COIL
"SPHEROCLAD CONSTRUCTION"



FREQ. COVERAGE—520—1600 Kcs.
TUNING CAPACITY—25—445 uufd. (includes strays)
PHYSICAL SIZE—1⅜" diam. x 2¼".
PIN CONNECTIONS
1—Grid.
3—AVC.
4—Plate.
6—B+.

MOUNTING—2 x ⅛" holes, 1⅜" apart.
PRIMARY INDUCTANCE, 8.5 mH..
SECONDARY INDUCTANCE when tuned to 1000 Kcs.—210 uH.
APPROXIMATE GAIN at 600 Kcs.—14 times.
SECONDARY "Q" at 600 Kcs.—140.

REMARKS

Construction is of 9/41 litz wound in special carbonyl pots giving extremely high "Q" and gain. Coupling is approximately .25. An inbuilt top coupling condenser of 5 uufd is used to increase high frequency power transfer

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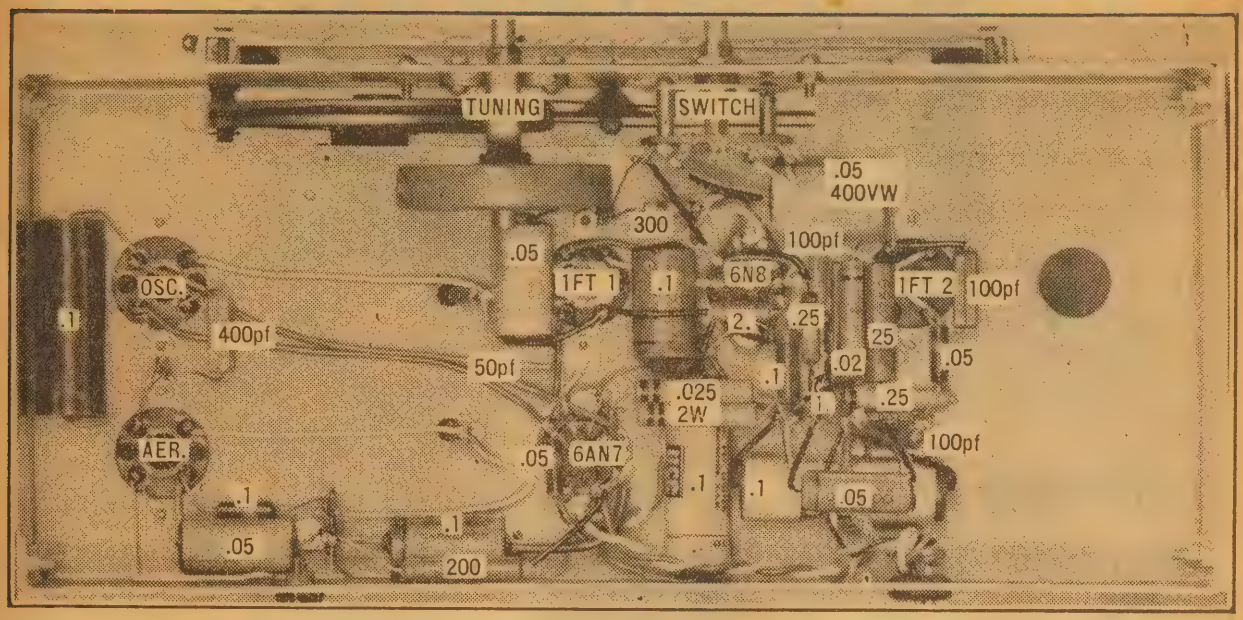
DUE TO PREVAILING CONDITIONS SPECIFICATIONS MAY CHANGE SLIGHTLY WITHOUT NOTICE.

UNDERCHASSIS OF PLAYMASTER BROADCAST TUNER



Here is a picture taken from under the chassis with the broadcast coils in place. It gives an excellent idea of layout and major component positions of the original. Exact positioning isn't critical, however.

mal way. The layout is so arranged that it may be built up either as a straight broadcast receiver, or as a dual-wave job. The circuit is the same for both versions, and the only difference is that whereas separate aerial and oscillator coils are used for the broadcast version, the dual-waver uses a small coil bracket instead.

UNIVERSAL CHASSIS

We accomplished this by keeping a chassis section near the gang clear of components apart from the coils. The chassis is punched for broadcast coil mounting, and the holes either ignored or blanked out if a dual-wave bracket is used.

The leads to the coils might seem a little long by this layout, but in practice their length proves no difficulty. They are somewhat shorter using the dual-wave coils, particularly if they are fixed to a small mounting bracket set back from the front of the chassis as shown in one of our photographs. We rather like this idea, particularly as such a bracket is quite easy to make, although the coils can be mounted direct to the chassis front.

With the bracket, broadcast performance is substantially the same as with the straight broadcast coils, but, in addition, you can have quite good overseas reception of the short waves. Many of the stations are so strong that they rival the locals in signal strength. All the coil brackets we have tried out to date have worked very well on both bands, and they may all be fitted to the chassis.

It's important to make sure you have a dual-wave glass on the tuning dial if you want dual-waves, and in any case it's an insurance against possible addition of the bracket some time in the future. Watch, too, that the short-wave range is the one you will want—some coils cover 13-42 metres and others 16-50 metres. The latter are often more efficient and easier to line up.

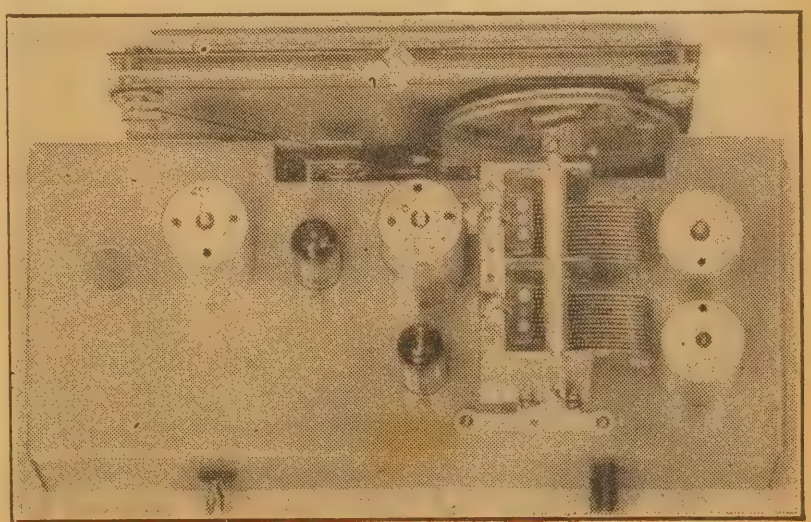
Because the circuit is the same for both tuners, we have shown it once only, but we have printed two pictures of the chassis from underneath to show how it looks with each type of coil. The dual-wave picture also shows the 10 kc whistle filter mounted in position, of which more in a moment. These two pictures should help you quite a bit if you are still something of a beginner at the game.

Another variation from straight circuitry is the inclusion of a variable selectivity switch.

This switch when in the wide-band position removes the second IF transformer from circuit, and substitutes instead a resistance coupled circuit. This process reduces the IF circuits to two instead of four, with a very noticeable reduction in selectivity. This again means that the side-band cutting of the circuit is very much less than it was, and the high frequency response of the tuner appreciably improved.

A test can be made by tuning to a station in the "normal" position, and then detuning to one side until you have only the slightest bit of "side-band" left. In this position it is probable that you will hear a second station on the adjacent channel playing away in the distance.

If you now switch over to the "wide-band" position the station you just tuned out will once again become audible quite plainly, and you will have to tune even further to the side before it is lost a second time. The difference between the



The tuner from above with the broadcast coils in place. The unused small socket hole at the left takes the cathode follower valve if the whistle filter is added.

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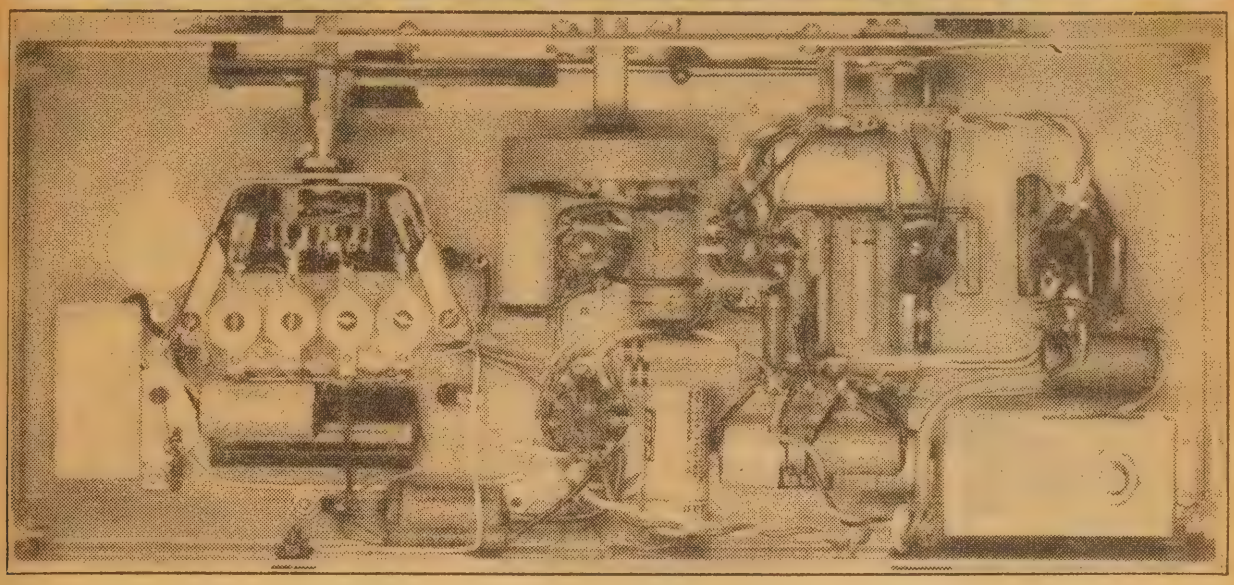


This underchassis picture shows the dual wave bracket in place, and also the whistle filter and cathode follower. Otherwise the chassis is the same as for the broadcast version.

two points at which the station is lost will indicate how much the band-width of the tuner has been increased in the wide-range position.

You will notice at the same time that the higher frequencies are much improved. Music is crisper, and voices are more natural. The resistance coupled circuit will reduce sensitivity quite noticeably, but a little higher setting of the volume control will remedy this.

We can improve the wide-band effect by using a medium or low selectivity intermediate in No. 1 position. This is the coil which is left in circuit in the wide-range position, and the poorer its selectivity the wider will be the band-width. In this position we require selectivity only good enough to separate local stations. If No. 2 IF is of a high selectivity type, the net effect in the "normal" position will be much the same as it was with two normal IF transformers.

HETERODYNES

When we have to consider wide-band reception, even on the scale represented here, we are liable to come up against trouble from 10 kc whistles generated by stations adjacent to some of the locals. The whistle occurs when the relative signal strengths are sufficient to generate a heterodyne strong enough to force itself through the band-width of the tuner. In the "normal" position, the attenuation at 10 kc is great enough to suppress such whistles.

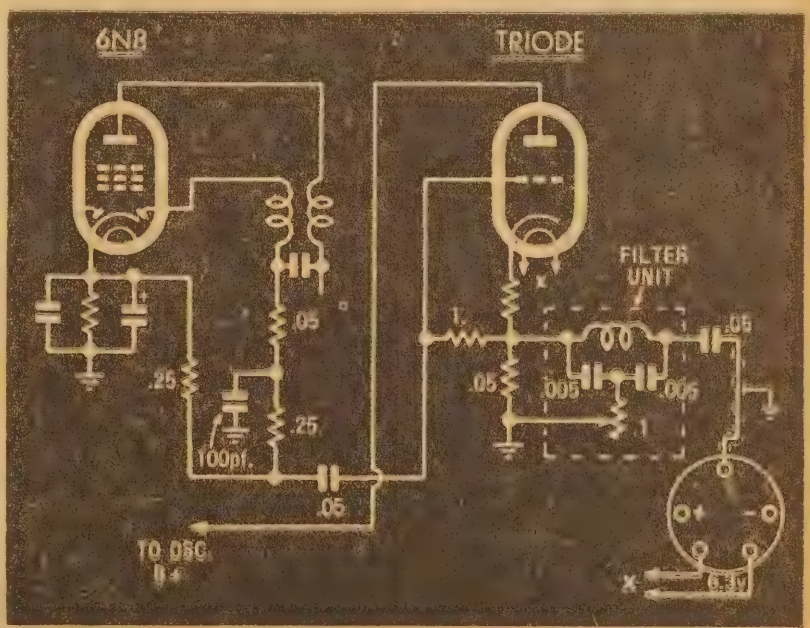
The only way to remove the annoying, high-pitched heterodyne without cutting the band-width is to use a filter in the output of the tuner which will absorb a narrow frequency band centred in 10 kc. The filter consists of a coil, two condensers and a variable resistor, which are adjusted to have an extremely high impedance at 10 kc. It tunes very sharply, so that attentuation is not serious over a band wider than about 400 cycles.

Unfortunately, it isn't practicable to insert this filter directly in the diode circuit of the tuner because it requires a low impedance input to avoid serious shunting of high frequencies. We have overcome this difficulty by adding another valve as an output stage operating as a cathode follower. Almost any valve at all connected as a triode can be used here. There is no gain in the stage, and as long as the impedance of the circuit is low, it doesn't matter much about the exact figure. A cathode follower circuit has an output impedance approximately equal to 1/Gm.

It is a good thing in any case to use a low output impedance circuit to couple the tuner to the control panel as there is less danger of hum pick-up and attenuation through the shielded cable.

The coil is wound on an RCS moulded choke bobbin with 3000 turns of 37 enamelled wire. The diagram shows how this bobbin is mounted into a metal bracket at one end by a wooden plug (we used a piece of threaded plastic stand-off) and tuned with an iron slug from an old IF transformer. The condensers are of .005 mfds, and the potentiometer .1 meg.

Adjustment consists of tuning the coil to 10 kc and adjusting the pot. for maximum attentuation. Approxi-



Here is the wiring of the cathode-follower for the whistle filter unit. For low-mu triodes, use 2500 ohms from the cathode to the junction of the 1 meg and .05 meg. For medium-mu triodes up to a figure of about 60, use about 1500 ohms. Triodes with "mu" much higher than 60 are not recommended.

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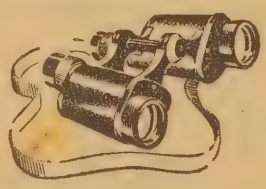

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mate setting of the resistance will be about 30,000 ohms, and for a start, it should be adjusted to about one-third rotation from the "o" position. The slug is now adjusted until a point is reached at which the whistle shows a marked decrease. The two adjustments may now be operated together, remembering that the slub will tune the coil to the 10 kc frequency, and the resistance will determine the amount of attentuation obtained. It should be possible to remove even a bad whistle.

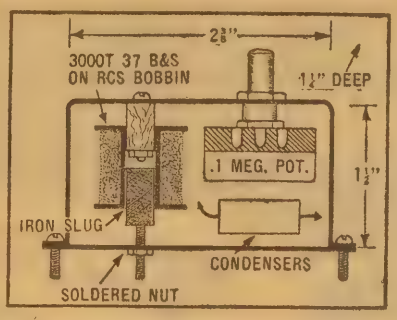
It is quite likely that most constructors won't be bothered with heterodyne whistles of this nature, as even in the wide-range position, the tuner still has plenty of 10 kc attentuation. However, we have given instructions for its inclusion in case it should be required. The general operation of the tuner will not otherwise be affected.

Connection to the tuner is made via a 5-way cable wired directly into the circuit at the tuner, and terminating in a 5-pin plug which fits the 5-pin socket of the control unit. One of these leads will be the output lead from the diode circuit, and this lead should be made with shielded wire. A piece of 72 ohm co-axial cable is best because of the low capacitance but a piece of braided hook-up wire will do if the lead isn't more than a few feet. Use the heavy gauge braided wire in order to keep the lead capacitance down to a minimum.

Note that the filament circuit is not to be earthed in the tuner. This circuit is already earthed in the amplifier, and damage will be done if it is earthed anywhere else.

TUNER OUTPUT

The output from the tuner is taken from a divided diode load, which uses only half the voltage available from the diode circuit. This has been done in order to reduce the possibility of the diode output voltage being too great for convenient operation with the control units.



This diagram shows the general construction of the whistle filter unit. For this set, mount the inductor on the opposite face so that the slug protrudes on the same face as the potentiometer shaft.

In the case of Control Unit No. 1, the input from the tuner is shown running direct to the grid of the first triode section. In most cases, the action of the AVC will be enough to see that the triode is not overloaded unless possibly a long outside aerial is used.

But there will be cases in which one or more stations are received at great strength, and the available diode voltage may be too much for the input grid of the control unit.

Tapping down the diode load by adjusting the values of the two load resistors will overcome this. We have suggested values giving a 50-50 division, but this can be varied to give, say, a 70-30 or 80-20 division.

If this reduction means that the weaker stations are now too weak, it is a simple matter to modify the Control Unit No. 2 so that the radio input runs straight through to the volume control in the radio position. This should only be necessary in special cases.

In the Control Unit No. 2 the position is slightly different, as the radio input runs to the volume control in any case, and thence to the amplifier via the extra compensation stage. In this case, the divided diode load merely reduces the voltage on radio to avoid the need for operating the volume control inconveniently near its minimum setting.

In general, a tapping well down the diode load is good, as it lowers the output impedance of the circuit from the tuner, and reduces the danger of hum pick-up as well as lowering distortion. It is a point on which experiment is in order, taking care that the total value of the two resistors making up the diode load is approximately .5 megohms.

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LINING UP A D/W COIL BRACKET

In this article it is proposed to outline the alignment procedure for a standard dual-wave coil bracket without an RF stage. The procedure applies also to units with an RF stage, although there is one more section involved. This section merely requires a straight adjustment similar to that for the aerial section and in step with it.

A DUAL-WAVE bracket has two sets of coils, one for the broadcast band, and one for the short waves. As each band requires an aerial and oscillator coil, there are four in all. A switch is included so that the aerial and grid of the aerial coil, and the plate and grid of the oscillator coil may be switched into the circuit according to the band you wish to use.

Earth, AVC and HT connections are brought to common leads on the bracket, as there is no need to switch them.

The coils are provided with trimmers for alignment, as obviously it is no longer practicable to use only one set of trimmers mounted on the gang.

Some of the brackets have iron-cored coils, using the familiar slugs down the centre, while others have no such cores. Both types will give good results, but a different alignment procedure will be followed for each. In addition to the trimmer condensers, the air-cored coils (no slugs) have a broadcast padding condenser which is adjusted during alignment. The iron-cored coils have no such condenser. The "padding" is carried out by slug adjustment in a manner to be described.

When mounting these brackets, take care to see that the grid leads, and the oscillator plate lead are kept as short as possible. On short waves, these leads represent an appreciable amount of inductance, and can prevent you from reaching the highest frequency setting if too long, and may also upset the dial settings. Long leads, too, are apt to allow feedback and oscillation, and the leads mentioned should be kept spaced away from each other as much as possible.

CORRECT DIAL

The earth, AVC and B plus leads are not so important, and may be of almost any length, although the AVC condenser bypass should be made right at the bracket.

In the equipment described in this issue, lead lengths are satisfactory, and these examples may be taken as about the normal limits for layout and lead length.

For the purposes of describing procedure, we will deal separately with the air-cored and iron-cored brackets. In both cases we set about alignment of both bands quite separately ,and one has no connection with the other.

Before lining up, it is essential to see that the dial you use is the type specified for your gang condenser. If not, it is unlikely that the station marking will coincide exactly over the full range.

Start also by ensuring that the dial pointer marks the exact end of the tuning scale when the condenser is fully open or closed. If this is not done, you may not be able to obtain exact registration between stations and dial markings. Tighten the dial grub screws firmly to be certain there will be no slippage on the condenser shaft.

Some dual-wave units cover from 13-42 metres, and others from 19-50 metres with a slight leeway each end. It is somewhat easier to make coils of the 19-50 metre type and they are less sensitive to long leads. However, both types seem to work quite well. Be sure that your tuning dial has the correct short-wave scale for the band coverage of your unit.

Lining up these coils is exactly the same as for a straight broadcast set. Study the maker's instruction sheet, and identify from it the broadcast aerial and oscillator trimmers, and the padding condenser.

AIR-CORED BROADCAST

The first thing is to receive some kind of a signal and identify it. The aerial and oscillator trimmers should, therefore, be slackened off about half-way (fully off means that the plates are just beginning to spring apart) and a station tuned in at the high frequency end of the band (condenser nearly unmeshed or open). In Sydney you should be able to hear 2SM. Now adjust the aerial trimmer for good volume.

The next step is to bring 2SM to its right spot on the dial.

This is done by adjusting the oscillator trimmer and following the station by returning the dial. If 2SM is too near the centre, tighten the trimmer. If it is too far down the bottom end, slacken the trimmer.

The station may decrease in volume as you do this. If it gets too weak, reline the aerial trimmer to bring up volume once more. Eventually you will have guided the station opposite its dial marking, and adjusted the aerial trimmer until the signal is loudest.

Now swing the dial to a station at the other end — say 2FC. It will probably come in quite well, but at a wrong position.

To get it right, you now adjust the padder condenser without touching either of the trimmers. If 2FC is too near the centre of the dial, slacken off the padder. If too near the top end, tighten it. You must, of course follow the station by retuning the dial at each adjustment.

When you have guided 2FC to its rightful spot, this should also be the one at which you hear it loudest.

This adjustment may have upset the oscillator trimmer, so forget the padder for the moment, and tune to 2SM. If it has moved, bring it back to the correct dial position with the oscillator trimmer, once more and adjust the aerial trimmer. Back a second time to 2FC to make sure it is still OK. If it has shifted slightly, a touch on the padder will bring it right.

As a last check, tune in a weak station below 2SM — one of the country stations — and carefully adjust the aerial trimmer for loudest signals. You can do the job just by peaking this trimmer on general noise level.

Remember — use the oscillator trimmer to adjust station positions at the 2SM or high frequency end of the dial, and the padder for stations at the opposite end. The aerial trimmer is adjusted on the high frequency end, and its setting should hold good for the rest of the band.

Lining up the short wave coils is much easier because there is no padder adjustment. The padder is a fixed value ready wired into the unit.

Set the trimmers about half-way, tune to the high frequency end — about the 19 metre band — and adjust the aerial trimmer for loudest signals or noise.

Identifying the bands isn't really hard, as the groups of stations are pretty sure to be heard somewhere near their right dial markings. If you can tune in some amateurs on the 20 and 40 metre bands, that's a further help. Once again, the oscillator trimmer will move stations up and down the dial, and the aerial trimmer adjusted for best volume. Always adjust the aerial trimmer near the high frequency end — preferably about one-quarter of the dial from the very end.

IRON-CORED BROADCAST

It is possible to hear strong stations at two spots on the dial with almost any short wave tuner, so don't panic if you notice this. The right signal to select is the one nearest the high frequency end of the dial. This means that, although you may hear a strong 19 metre station repeat itself among the amateur stations, you should peak the aerial trimmer on the signal which is heard on the 19 metre band.

If all is in order, this alignment should hold over the complete short wave band. You may find that sensitivity as indicated by noise level isn't quite even from one end to the other, but the set when connected to a good aerial should sound quite lively all over.

Procedure with iron-cored coils is a little different, but not more difficult. The main rule to remember is that whereas all adjusments at the high-frequency end are made with the trimmers, those at the low frequency end are made with the iron cores.

Start out listening for 2SM. Having roughly lined the aerial trimmer for best sensitivity, guide 2SM to its right spot on the dial by adjusting the oscillator trimmer. The aerial

(Continued on Page 92)

Here's your answer, Tom!

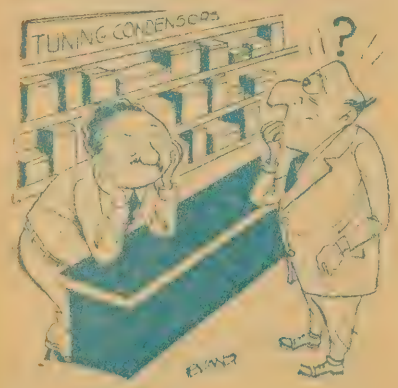
Our thanks are due to Tom this month for bringing to light several queries which bother some of our less experienced readers. The answers are well known to the old hands and for this reason may be missed out in the usual technical articles. It is often the obvious question that proves the most interesting when one takes the trouble to "dig" into it.

A GOOD many radio hobbyists who confine their activities to broadcast and dual wave receivers never have reason to question the specifications of tuning condensers: If they decide to stick to fairly standard circuits they simply use standard tuning capacitors and have done with it.

But Tom asks:

What value should be chosen for tuning when no value is given by the circuit diagram?

As a general rule it can be taken that a standard broadcast band tuning condenser having a range of from about 10 to 400 pf is required. With this value and standard tuning coils it is possible to cover the range of from 550 to 1600 Kc with one sweep of the dial. All broadcast stations within Australia are within this range.



Should you use a condenser smaller than the standard value, you simply will not be able to cover the full range. At one time it was thought that the upper limit of the broadcast band would always be 1500 Kc, and there were several types on the market with a smaller range than is standard at present.

If you wish to use one of these in a modern receiver it will be difficult to cover the full band. By adjusting the iron slugs of the coils, you will most probably be able to get all stations at the low frequency end, but you will miss out on the high frequency end.

This is not as much of a disadvantage as it would appear since, as far as we know, there are no stations yet in operation between 1500 and 1600 Kc, and if you are a city dweller, you won't normally bother about the stations right at the bottom of the dial.

Certain old-fashioned tuning condensers had a greater capacitance range than the present standard. If you wish to use one of these, the main objection, apart from mechanical considerations, is that the set won't line up with a modern, station-calibrated dial.

This does not matter a great deal in the case of crystal sets and small regenerative receivers, but with bigger sets, most people would like to have the stations appear where they are marked on the dial!

To obtain accurate calibration it is necessary to use a dial and condenser designed to work with each other. Some compensation for unmatched types can usually be made during the alignment process, but it is easier if you have the correct coils.

Of course, where there are no stations near the end of the band as is the case in Sydney, it is often possible to do a bit of juggling and make the stations track reasonably well, even if the gang and dial do not match. But this is doing it the hard way, Tom!

What do you mean by "strays"?

Something quite different from the local pound-keeper, Tom! The word is simply part of the accepted technical jargon and refers to the unavoidable stray capacitances which are part of every radio set even though they do not appear on the circuit diagram.

Are there any special differences between tuning capacitors used for Australian sets and those used for English and American sets?

We do not have the exact figures for the English and American broadcast bands available but both English and American sets which have been brought to this country appear to be capable of receiving our local stations, so we imagine that the bands are almost the same, in which case the tuning capacitors would have about the same range.

If you find an interesting circuit in an overseas magazine you would like to try, there is no need to worry about slight differences in the band coverage since you would normally use coils, dial and tuning capacitor of Australian manufacture.

Is the minimum capacity of a tuning capacitor very important?

In practice, Tom, the minimum capacitance of a tuned circuit is determined by the distributed capacitance of the coil and the capacitance of the trimmer, in addition to the minimum capacitance of the tuning capacitor. If, for example, the minimum capacitance of the tuning condenser is high, it will be necessary to use a lower value trimmer than normal, and the total capacitance in the circuit works out about the same. In the same way, the trimmer is used to compensate for variations in wiring and other unavoidable circuit capacitances.

Normally, the minimum capacitance of the tuning condenser is small compared with the sum of the other minimum capacitances and its exact value does not matter, although it should be as low as possible. In most cases it is somewhere about 10 pf.

Trimmer capacitors also are often shown on circuits without a value. How do you know what value to use?

We are very much afraid, Tom, that this is another occasion where you are supposed to know intuitively what value to use. However, as with the tuning capacitors, trimmers have become standardised over a period of years and most trimmers have a range of from 2 to 30 pf approx.

Since the trimmers are set to the required value, which is less than 30 pr, the exact maximum value is

not of such great importance. For example, if allowing for strays, a capacitance of 15 pf is required to bring a particular circuit into line it is not very important whether the trimmer has a maximum capacity of 20 or 30 pf.

It is much more important to make sure that the trimmer has good mechanical characteristics. Having been adjusted it should hold its adjustment over a period of time,

whether it be subjected to heat and humidity or vibration.

Nothing is more annoying when aligning a receiver than trimmers which will not adjust easily and smoothly. Always make it a rule to check all trimmers for ease of operation before starting the job, because it is most distracting to have to make mechanical adjustments to trimmers in the middle of an alignment job.

Most broadcast and dual-wave receivers employ compression type trimmers. They consist of a small piece of sheet metal, usually attached to an insulating base of some kind, which is separated from a second piece of sheet metal by a thin slab of mica. The second piece of metal is bent or curved in such a way that most of its area tends to spring away from the first. Some form of screw is used to press the two plates together and thus vary the capacitance of the trimmer.

While these are satisfactory for relatively simple receivers they have a number of disadvantages. For various reasons the capacitance range of different units of the same type cannot be guaranteed to be the same. The degree of turn of the adjusting screw for a given capacity range is different throughout the range, and finally, they are not completely free from the effects of variation in temperature and vibration.

A better form of trimmer, and one which is turned out by several manufacturers, consists essentially of a small metal cylinder turned or pressed from thin sheet metal into which a second cylinder fits, allowing a small spacing of air between the two. The value of the capacitor depends on the distance one cylinder is pushed into the other. This is precisely controlled by a spring-loaded screw which gives a linear change of capacity throughout the range for a given number of degrees rotation of the screw. A greater capacitance can be obtained within a given space by arranging several cylinders co-axially, one inside the other.

Some of the higher priced receivers use trimmers very similar to ordinary tuning capacitors in order to obtain smooth and precise adjustment.

Why do tuning capacitors have specially-shaped plates?

Originally, Tom, tuning capacitors were made with semi-circular shaped plates, but it was found that this caused the stations to be spread unevenly over the dial.

Say, for instance, that it is required to cover the range from 500 to 1500 Kc. Starting with the moving plates right out, the first 20 degrees of rotation may tune from 1500 to 1000 Kc, while the remaining 160 degrees of rotation are required to tune from 1000 down to 500 Kc.

This is not a very happy arrangement because there are just as many stations between 1000 and 1500 Kc as there are between 500 and 1000 Kc.

In practice, the effect is that you need a micrometer adjustment at one end of the band, while the stations are as broad as the proverbial barn door at the other.

The frequency range over which a capacitor will tune is dependent on the ratio of the circuit capacitance with the capacitor plates fully in mesh to the circuit capacitance with the plates fully disengaged.

With the semicircular-shaped plates, a given number of degrees of rotation at any section of the dial will give the same change in capacitance. Toward the low capacitance end of the dial, for a given number of degrees of rotation the ratio of change in capacitance to minimum capacitance will be high since the minimum capacitance is normally quite low.

However, toward the low frequency end of the band the amount of capacitance in circuit is high and the same number of degrees of rotation will result in a smaller ratio of change in capacitance to minimum capacitance.

Of course, you could instal a large fixed capacitor in parallel with the variable capacitor to make the tuning more even, but this would upset the efficiency of the circuit and the tuning coverage.

A far better approach is to shape the plates so that toward the low capacitance end of the band a given number of degrees of rotation gives a smaller change in capacitance than at the high capacitance end of the band. The standard tuning capacitors used in most receivers nowadays are practical examples of capacitors made with this idea in mind.

What causes the blue glow in radio valves and does it indicate that anything is wrong?

A blue glow between plate and cathode indicates gas in the valve. Certain valves, notably heavy duty rectifiers and power amplifier valves may have less than the rated amount of gas and at the same time exhibit quite a noticeable glow. If the valve is a good one, the color will usually be confined within the plate of the valves.

Do not be confused by mercury vapor valves, which normally have a strong blue glow throughout the envelope.

Neither should this type of blue glow be confused with the fluorescence which makes itself evident in the form of a delicate deep blue glow close to the envelope of the valve. It often moves with the signal. With a little experience you will have no difficulty in distinguishing between the two, as in the case of fluorescence, the glow is usually sharply defined, while a glow due to gas tends to spread. Fluorescence is rather an indication of a good vacuum than of the presence of gas.

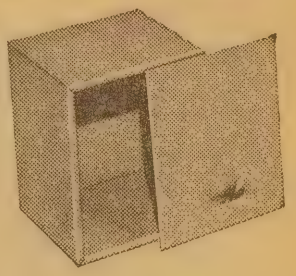
Could low resistance headphones be converted to high resistance headphones by adding some extra resistance? If so, with what effect?

If you were to wire a resistor of the appropriate value in series with a pair of low resistance phones you could make them appear to be of high resistance as far as the external circuit is concerned. However, most of the power from the receiver would be wasted in the resistance and, therefore, would not contribute to the audible sound. If the headphones are to be operated from a receiver with a power output valve, such as a 6V6-G this would actually be an advantage because the amount of power a pair of headphones can safely handle is limited.

But if you wished to operate a pair

(Continued on Page 63)

METAL UTILITY CABINETS



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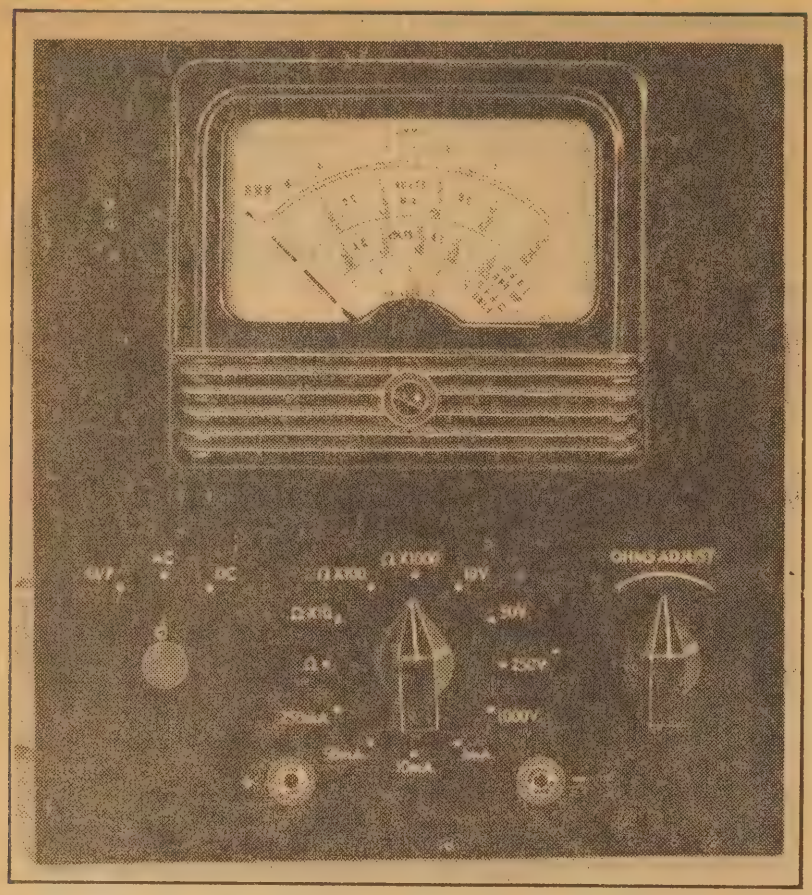


This front view gives a good idea of the appearance of the meter when using the label printed elsewhere in the article. The vacant hole on the left will take another switch when AC ranges are added.

LEARN WHILE YOU BUILD

Last month we introduced the subject of multimeters and detailed the operation of the ohmmeter. Having digested the "theory" you are, no doubt, anxious to proceed with the practical side. Well, here it is—how to construct and use the first section of the multimeter.

by Philip Watson

AS we intimated last month, we intend that you should tackle this project a small bite at a time, not so much because it is a complicated set-up (it is actually very much simpler, in many respects, than the project just concluded) but because there are quite a number of new ideas to be presented and explained.

It would be quite impossible to deal with all these adequately in one article and unless they are dealt with in detail the project will be of little value to the beginner—for whom it is mainly intended.

AN OHMMETER

As it is you can take things a little at a time, both structually and financially, and finish up with a very much better idea of what the whole thing is all about.

So much, then, for generalities, now let's get down to the construction of our first section—the ohmmeter.

First thing to be considered is the panel, it serves much the same purpose as the chassis of a receiver and upon which the main components are mounted. We used a piece of bakelite 8" x 7½" x 1-8". This size was chosen to allow it to be used with the same carrying case as was designed for our kit No. 3 multimeter. In place of bakelite you could use aluminium or even Masonite at a pinch, but for several reasons the bakelite is to be preferred. It is of neat appearance, wears well, and being a good insulator does not require insulating washers around the terminals.

The large meter mounting hole (3 3-16" in our case) was cut by drilling a circular pattern of small holes, just inside the required diameter, breaking the small sections between them and finally cleaning things up with a half round file. When holding this material in a vice make sure that it is backed up with a piece of solid wood as it is very brittle and easily broken.

THE METER HOLE

Next drill three 3-8" holes in the panel below the meter to take the two switches and the zero adjusting potentiometer. Although only one switch will be mounted at the moment it is advisable to drill all the major holes before you commence assembly as it can be an awkward job when the unit is partly finished. Before actually mounting the switch and pot, cut the shaft to the correct length for the knobs you are going to use. In our case we left about 3-8". It is also advisable to file a flat on the shaft to hold the knobs quite firm.

The actual method of mounting the meter and the number of holes required will depend on the particular model you chose. Although we consider the one we selected to be about the best all round size and style, other types can be used. A three-inch circular model is a very satisfactory substitute, being slightly cheaper, but still retaining the universal scale as in the larger one.

A smaller size than this would probably be unwise, even assuming that a suitable scale was available (which is unlikely) as such meters are really intended for more specialised applications where only one or two scales are involved and extreme portability is important. This must not be taken as inferring that such meters are less reliable, as, in the main, they use the same form of construction as the larger ones and in many cases the same parts, with the possible exception of the magnet. Rather it is simply that such a small scale is hardly suitable for an instrument of this type.

CHOOSING A METER

Meters larger than the one selected, although more expensive, do not always offer very much more than a change in style, the scale often being identical with that of the smaller one.

You will notice that the parts lists specifies the meter as having a non-

steel calibration. This refers to the panel on which the meter is to be mounted and which, if steel, can alter its sensitivity. The exact amount will depend on the thickness of the panel but for normal values it can cause an error of between two and four pc. If you intend using a steel panel (if not now, perhaps some other time) it is important to advise your supplier of the gauge of metal involved so that the maker can adjust the meter to suit it.

AVOID CHEAP METERS

Finally, don't be tempted to buy a cheap meter through disposals and expect to build it into this circuit with success. While it may not be correct to say that it cannot be done, for the beginner, at least, there are far too many doubts and unknown factors to make it a worthwhile proposition. In the first place it is seldom that the internal resistance is known and finding it, without the proper facilities, can be a difficult job, as well as risking severe overload of the meter.

Secondly, local makers can seldom supply suitable scales, and although these can perhaps be made by hand or photographically, it is hardly a job for a beginner. Finally, these meters carry no guarantee and if they are damaged it is often impossible to have them repaired, the parts used by local manufacturers not being interchangeable with those from overseas.

One of the problems associated with home-made test equipment is the provision of a suitable label to show the functions of the various switch positions, and such a label is essential if the meter is to be protected from serious damage due to the application of voltage or current to incorrect ranges.

One method is to have the panel engraved by a commercial engraver, and this makes a very good job if properly done, the black bakelite we used being particularly suitable for it. However, such facilities are not always readily available, particularly in country districts, and, in addition, a good job is fairly expensive.

Another idea is simply to print the neccessary markings on a piece of card and mount it on the front panel. This is certainly better than trusting to your memory, for a crude label with a meter that works is preferable to no label and a meter with its pointer wrapped around the stop. However, it's hard to make a good job by this means, and, unless you are a commercial artist it will always look home-made.

CONTROL LABEL

In an effort to overcome some of these problems we are publishing a suitable label, which you can mount on the panel under a piece of celluloid, holding it in place by means of the switch mounting nuts. This will give your instrument quite a professional appearance, and, even if you have ideas about engraving later on, it will provide a useful substitute in the meantime.

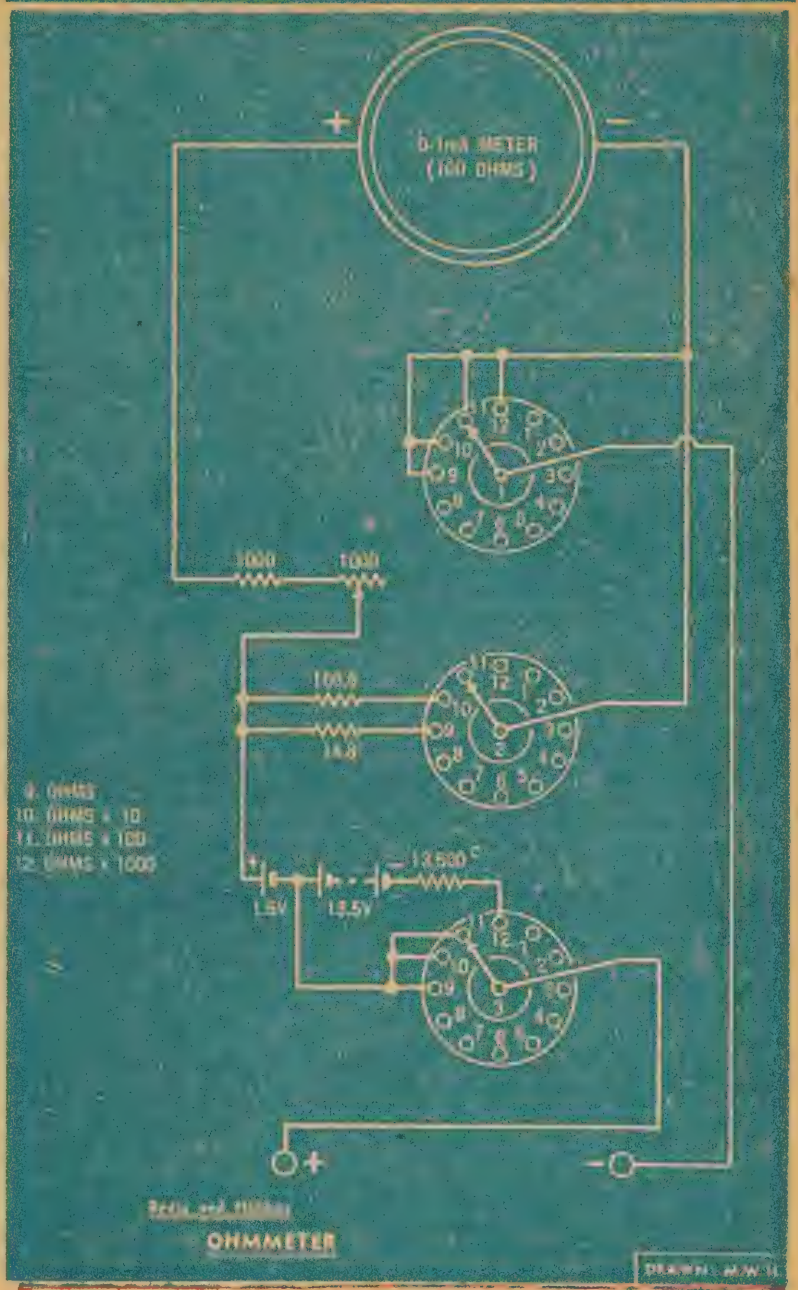
We have also designed it to be used as a drilling template, the centres of the holes being clearly marked, and it is only necessary to lay it on the panel and mark these positions with a sharp scriber or centre punch. It may be a good idea to have someone hold the label for you while you do the marking.

Next we come to the switch. This consists of three banks or decks, each of which has a moving contact capable of being set to any one of twelve fixed contacts. Careful examination will show that a certain amount of ingenuity has been necessary on the part of the makers to fit the twelve contacts into the space provided and, in fact, the twelfth contact is located on the opposite side of the deck to the other eleven. Further, there are two moving contacts, one for the eleven contacts and the other for the twelfth. These are the same electrically and should be connected together and treated as one, a job which is best carried out before the switch is mounted.

When soldering to switch contacts, particularly ones which will ultimately have high voltages applied to them, it is advisable to avoid the use of soldering pastes. When used, it is difficult to avoid getting some of this into the "works," and there is a very grave risk that it will ultimately cause a breakdown in the insulation—with disastrous results to the switch and, possibly, the meter. As supplied, these contacts are well plated, and no difficulty should be experienced in soldering with resin cored flux alone.

Circuits using switches of this type

CIRCUIT DIAGRAM OF THE METER



The circuit is extremely simple and you should have no difficulty in identifying the few parts and connections. Study it in conjunction with the coded photograph for further information.

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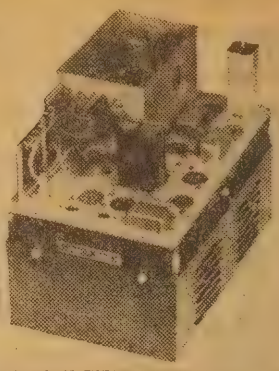

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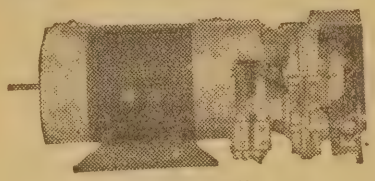

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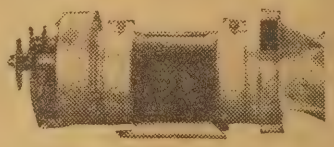

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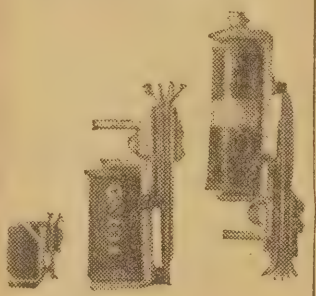

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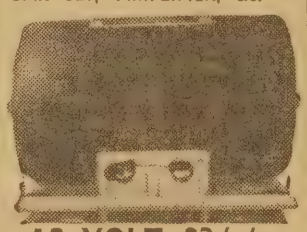

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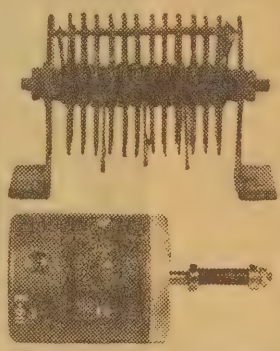

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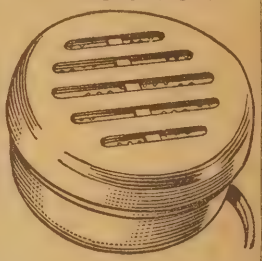

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are probably new to most of you, and may seem a little frightening. However, we have numbered the decks in the circuit, number one being that nearest the clicker plate. The individual contacts have also been numbered, the switch being viewed from the front, so that position twelve occurs when the switch has been rotated completely clockwise until it reaches its stop. The four ohmmeter positions are, therefore, 9, 10, 11, and 12.

THE POTENTIOMETER

The potentiometer is a perfectly standard wire wound type similar to that used in our previous project. The only point to be watched is that of the insulation of the shaft in the event of a metal panel being used. Normally wire wound pots have the shaft connected to the moving arm and when mounted on a metal panel need to be insulated. The necessary washers to achieve this should be supplied with it, but it is a good idea to check this point if you intend using a metal panel.

To mount the various small components you will require a length of resistor strip, a piece about 6in long and having 12 terminals on each side being a convenient size. It is well worth while getting a good quality item, the type having secure brass terminals, heavily silver-plated, being ideal. This can be mounted on the meter by means of the meter terminals, it only being necessary to enlarge two of the holes in the centre of the strip. When replacing the terminal nuts don't forget a solder lug under each to provide connection to the meter.

A good idea of the layout can be obtained from the photographs, the rear view having been coded to help you pick out the individual parts, and with so few parts the assembly should not present any difficulty.

Now you can start thinking about the wiring. The circuit diagram should provide all the necessary information, particularly as only a small part of the wiring is to be done at a time, and thus involves only a few connections. Wiring may be done with either stranded hook-up wire or single-tinned copper wire of about 18-gauge in conjunction with spaghetti sleeving. The former method is probably the easier of the two, but the rigid wiring makes a neater job, so you can please yourself. The efficiency of the instrument will not be affected no matter how it is wired, though, quite naturally, you will want to make a neat and workmanlike job.

PARTS LIST

1 0-1 mA. meter, 100 ohms interna resistance, universal scale S4-46A or similar, non steel calibration.
1 3 Bank 12 position switch with shorting type contacts.
6" of resistor strip having twelve contacts on eash side.
1 Bakelite panel 8" x 7½" x ⅛"
1 1000 ohm potentiometer.
1 1000 ohm 1 watt resistor 10%
1 13.000 ohm 1 watt resistor 1%
1 14.8 ohm shunt
1 166.6 ohm shunt
1 950 type cell
1 703 type battery
1 Pair test leads
2 Tip jack sockets
3 Pointer knobs
Solder lugs, hook-up wire etc.

In any case it is a good idea to use bare tinned copper wire for the short connections between switch contacts, insulation in this case being unnecessary, and the handling of very short lengths of hook-up wire being a tedious business.

It is helpful to set the switch to each range as it is about to be wired, thus indicating the particular contacts involved and avoiding the rather exasperating experience of completing the wiring, only to find that the switch markings are one position out with reference to the switch settings—or something equally silly!

With all the wiring completed, check it over very carefully (remembering that your meter is easily damaged), then plug the test leads into the panel sockets, set the switch to any of the three lowest positions, and quickly flick the two ends of the prods together. If the meter shows signs of distress, such as an extremely rapid movement to full scale, it is a sure sign of trouble and calls for further checking.

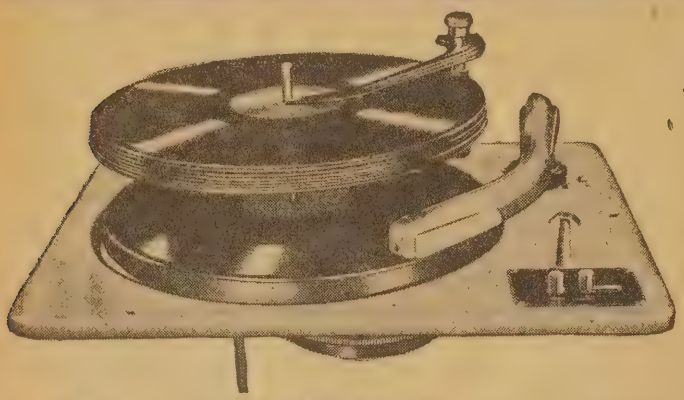
METER SETTING

If all is well the needle will come up to approximately full scale and may be adjusted to the exact value by means of the zero adjusting pot. Now check it similarly on all the other ranges and if satisfactory you may prepare for some further tests. An ideal test is a set of resistors having values of 15, 150, 1500, and 15,000 ohms, each of which should give a half scale reading on the appropriate range.

While you are not likely to have such a set of resistors readily available you may be able to find a few of similar value and these will indicate whether each range is working correctly. Actualy such a test is hardly necessary, but on odd occasions shunts go open circuit or may be wired to a blank lug, in which case two ranges may have the same sensitivity without anything to indicate that such is the case.

In all probability you will find that everything works correctly from the start, and if so, the next step is to familiarise yourself with the operation of the instrument—and learn something of typical receiver values —by making as many measurements

two of the best...



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E1/266

as you can on the nearest receiver.

If you have built one of the receivers described in our first project you will probably find it the most convenient to use as a guinea pig and on this assumption we are detailing some of the resistance measurements made on our own "Superhet four" chassis. Even if you have not progressed this far to date you will still find many of the values useful, as the power supply section is similar for most models, as are also a number of individual components.

SWITCH OFF!

However, before you go any further, a word of warning. Don't, in any circumstances, attempt to measure resistance in any part of the chassis while the power is on. This applies to all sets, whether AC or or battery operated, since the sensitivity of the meter is such that it will most certainly be damaged if even moderate voltages are applied to it.

The measurements you make yourself will not necessarily be exactly the same as those we have quoted, particularly where coils and transformers are concerned, since components from different manufacturers will vary slightly. However, they should be of the same general order and a variation of a few per cent is of no importance.

The values we have listed are those which are not generally marked on circuit diagrams, and should thus be of particular interest to the beginner when tracking down troubles. The actual resistors in the set, whose values are given, should also be measured and the readings compared with the circuit diagram. A little practice along these lines will iron out any minor problems which might arise in reading the scale or in transposing from ohms to megohms.

WINDING RESISTANCE

Measurement of the power transformer primary resistance is quite straight forward, and will normally be made on the lowest range. You will notice that our figures for the secondary show a slight difference each side of the centre tap. This is quite normal and is due to one half of the secondary being wound outside the other. This means a greater length of wire in order to obtain the same number of turns, and, therefore, a slightly higher resistance. The effect on voltage balance is negligible.

In this particular set there is no circuit from the HT line to the chassis, or negative side of the circuit, and the meter should indicate very close to infinity. It won't quite reach the end of the scale, however, due to a small amount of leakage through the electrolytic condensers. In fact when the prods are first applied the needle will move to full scale, then slowly move back as the condenser is charged.

Another point to watch when electrolytics are involved is the polarity of the voltage applied to them by the battery in the ohmmeter. If you trace the circuit you will find that the polarity indicated on the panel terminals is the opposite of that actually present when the meter is used as an ohmmeter. This is quite normal with most ohmmeter circuits, which are part of multimeters, and is rather difficult to avoid without additional circuit complexity. In most cases it is quite unimportant but if reversed voltage is applied to an electrolytic it will show excessive leakage. In the case of the three lower ranges the voltage is not sufficient to show this effect to any marked extent, but it is quite definite on the "ohms x 10,000" range. Thus, to get a correct reading, the "negative" lead should go to the HT line and the "positive" to chassis.

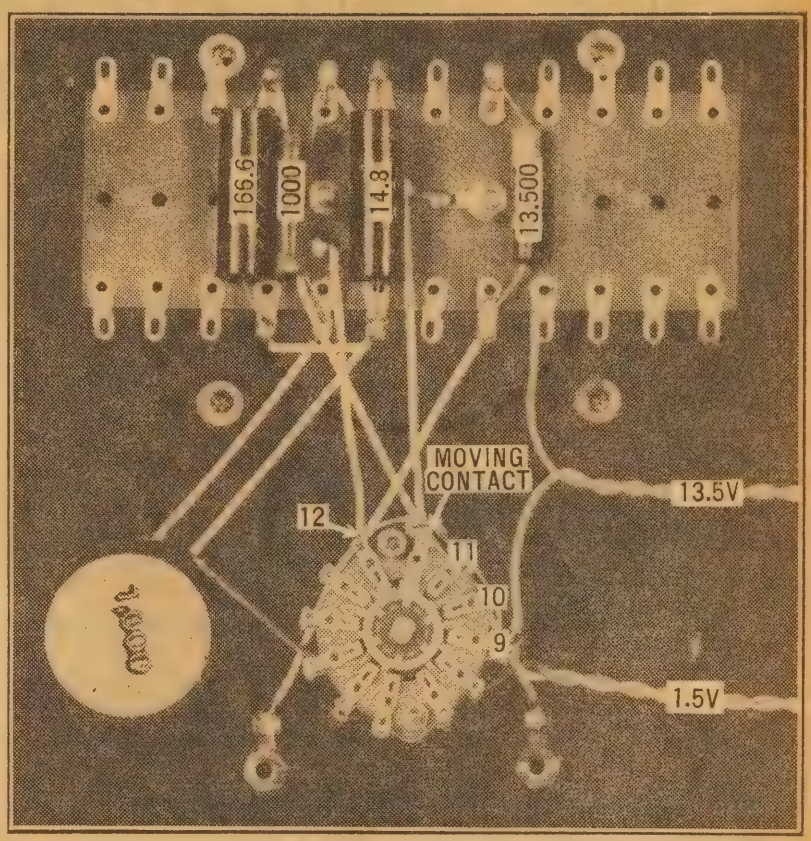
Electrolytics which show very low values of resistance can be regarded as faulty, but it is advisable to allow some time for a stable reading to be reached, particularly if they have not been used for some time, as it is necessary for the electrolytic film to "form" before the condenser can function properly.

PAPER CONDENSERS

The larger values of paper condensers (.1 or .5 mfd) will also show a low "resistance" when first connected, but should rapidly return to infinity. Any measurable resistance on the highest range will indicate a faulty condenser. Lower values, such as the mica types, will often not cause any appreciable movement of the needle as they charge, but should also read infinity on the highest range.

You will also find that the highest range is sensitive enough to read the resistance of your own body and if you get your fingers on the prods this will cause considerable error in your reading.

REAR VIEW OF THE METER PANEL



This rear photograph shows the placement of all the components which have been marked for ease of identification. The two twisted pairs are leads for the 1.5 and 13.5 volt batteries.

The value given for the speaker transformer may puzzle some, the value of 500 ohms for a 5000 ohm transformer being hard to reconcile. The solution is that the 5000 ohms refers to the impedance of the winding when it is coupled to a correctly loaded secondary circuit and this bears little relation to the DC resistance.

The measurement of the choke is quite straightforward, but it is interesting to note the effect of inductance as shown by the sluggish movement of the needle.

The primary and secondary windings of IF transformers normally have the same resistance, but you will notice that there is a slight difference between the values for the first and second transformer, the latter being designed to work under slightly different conditions from the first, namely, into the diode circuit.

The aerial coil used in this set was the Reinartz coil used for our previous models and the resistance of the primary winding is lower than that of more conventional types, which is in the order of 35 ohms.

Finally, a point to watch when measuring resistors in a chassis. The resistor you are measuring can quite easily be shunted by another in some other part of the circuit, and this will result in a false reading. This is the first thing to suspect if the resistor you are measuring shows a value very much lower than its marking, for resistors do not, as a rule, decrease appreciably in value.

(Continued on Page 96)

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FROM THE SERVICEMAN WHO TELLS

While continuing our discussion on typical test equipment for a service business we approach the problem this month from a somewhat different angle. The case history deals with a problem of ignition interference in a car radio, and should be of particular interest to those who like to install their own.

SO far our "advice to the budding serviceman" has covered the basically essential items — the bare minimum as it were—which will be needed to start a business. Once established you may well ponder on the value of what might be termed the "luxury" items of test gear, devices which, while not perhaps essential, do make one's work a lot easier and quicker.

Perhaps I am sticking my neck out in daring to draw a line of demarcation between what are essential and what are luxury instruments —someone is bound to query such a decision, but, after all, the line has to be drawn somewhere, and the term luxury is purely relative, anyway. It's very much the same as with a motor car—a luxury when the other fellow has one, but a necessity when you have one of your own!

ESSENTIAL CLASS

Anyway, I think it is generally agreed that the instruments we have discussed so far are in the essential class, even though it may often be possible to service a set without all of them. I have known chaps to boast that they could service a set with a screwdriver and a piece of wire, and they probably could, too, in a sort of way, but they could never run a very successful business on that basis.

Whether instruments other than these are essential is largely a matter of opinion. The thoroughly experienced servicemen, with years of practical work behind him, will have acquired a collection of tricks and short cuts, which can, if intelligently applied, render many of the more elaborate instruments unnecessary. He would, therefore, hesitate to invest good money in an instrument which is not likely to increase his working efficiency.

At the other end of the scale is the raw beginner (for whom this series is really intended), who seeks to make up for some of his lack of experience by providing adequate test equipment. This is a perfectly legitimate approach—providing the gear is used intelligently—and it certainly enables the beginner to get started earlier, and with more confidence.

SELECTION

Of course, there are extremes in both cases. There is the old hand who stubbornly refuses to accept new methods and new instruments, even after they have been generally accepted as being able to do a quicker and better job, and who is eventually left completely behind. This generally indicates an inability to keep pace with the times either in the matter of instruments or the science generally. The result, I'm afraid, is inevitable.

On the other hand the beginner can easily fall into the trap of loading himself down, financially, with every new device which promises to do everything but actually order a replacement part! (Well, maybe that is an exaggeration, but you know what I mean.)

Quite apart from the financial outlay he is trying to skip the most vital period of a serviceman's training, the period when problems—really hard problems—are inevitable and nothing but solid application and logical thinking will solve them. Lessons learned this way are not forgotten and, more important than the individual case, you are learning to use your training, to apply your knowledge, and to make the best use of your equipment.

Between these two extremes is the happy medium, the combination of adequate equipment and practical experience, which makes a good serviceman. After all, no piece of equipment can be regarded as a kind of crystal ball, into which one can gaze and be told the answer to a problem, any more than the serviceman himself can be regarded as a kind of mystic who can tell what is wrong with a set simply by looking at it.

SIGNAL TRACER

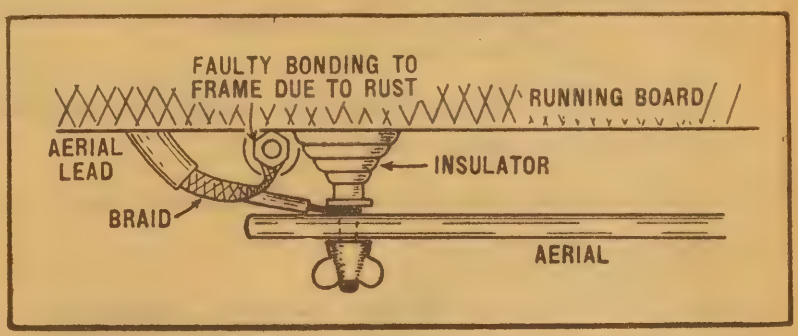
If I appear to be laboring this point unduly it is only because I want to present these so-called luxury items in their correct perspective, and because I have seen so many beginners make the mistake of imagining that a lot of equipment is the automatic answer to all their service problems.

Coming down to more tangible things I propose to deal with what is, I think, the most useful of these instruments—the signal tracer.

As I said earlier the old hand is often inclined to look askance at these devices, and mutter "sissy stuff," or some such derogatory remark, simply because he learned to work without them in the days before such refinements. Nevertheless, it is difficult these days to make a very convincing case against their ultimate inclusion in the test gear line-up.

As I have mentioned in these columns on many previous occasions the intermittent fault is by far the worst type which any serviceman, beginner or not, can have thrust upon him. And, I'm sorry to say, they are not getting any less frequent, rather the reverse, a fact which can only reflect discredit on the component manufacturers. But whatever the cause the result is that you, as the serviceman, will be called upon to fix it. What approach are you going to adopt?

I have heard of firms who flatly refuse to touch the things in any circumstances. You can take this stand if you like, but, I think, it's a very unwise one. If you won't tackle the job the customer will look for someone else who will, and a customer who goes elsewhere in those circumstances is not likely to come back. A few cases like that and you will be getting the kind of publicity that's fatal.



This shows the set-up for the running board aerial and how the earthing of the shield braid was affected by rust and dirt. A good bonding at this point is essential if complete freedom from ignition interference is to be avoided.

Or you can, more wisely, accept the job and tackle it with limited equipment. In many cases you finish up making nothing on the job, or even losing slightly, just to keep the customer's goodwill. While that may be good business policy on odd occasions, a little goes a long way, and it does not take many such to put you "in the red."

BETTER METHODS

Very often, due to financial considerations, this may have to be your policy for a start, but, once you have "settled in" and established the routine part of your business on a satisfactory basis, it is time to think of a better way to tackle this very real problem.

Although its prime purpose is the tracing of intermittents, the tracer is not solely confined to this job. If it were, one might be less favorably inclined towards the investment

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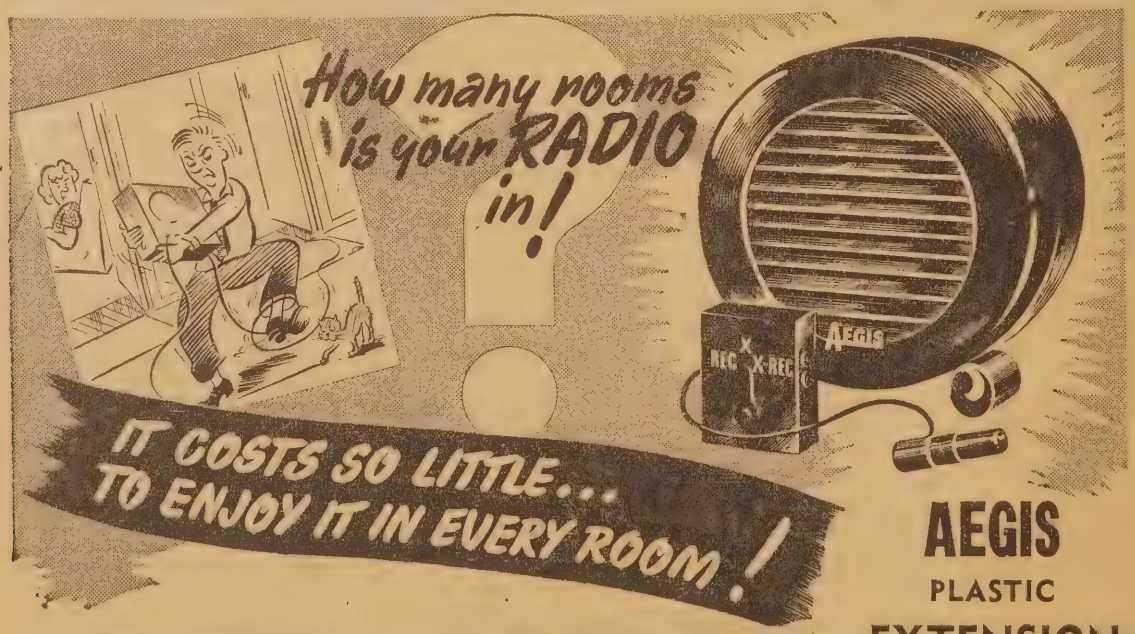

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for, valuable though it may be when needed, it would probably lie idle for 90 per cent of the time. Fortunately the tracer can be of very real value in finding the ordinary run-of-mill faults, which form the main part of your business, and, especially in the case of the not so experienced, can save much valuable time.

What is this process of signal tracing, anyway, and how does it differ from other methods of testing?

The usual method of testing, dynamic testing that is, is to feed a signal into various stages of the receiver and note the effect on the output. In many cases this consists of nothing more than placing the finger on the grid cap of a valve and noting the intensity of an inelegant burp in the speaker. It does not take much experience to be able to judge the gain of an audio stage with a surprising degree of accuracy, while results from the earlier stages, though somewhat less obvious, can still be extremely useful.

SIGNAL EXTRACTION

Of course, when this is inadequate, one uses the oscillator and since its output can be accurately controlled a more exact measurement is possible. This, then, is what may be termed a servicing by signal injection.

By contrast, signal tracing is a form of signal extraction, which allows us to take a signal out of the receiver at any stage, the other essential difference being that the test signal is being passed through every part of the set rather than a portion only. This is an important difference since it allows the set to be tested under more nearly normal working conditions and will often show up a fault, particularly some of the more obscure type, which would be overlooked by the previous method.

When it comes to intermittents it is this feature which is of prime importance. Take as an example a set with an intermittent in the converter stage. If checking with an oscillator (it is assumed that all the more obvious tests have failed, and that this is a real "stinker") the usual method would be to check the sensitivity of each stage when the set was performing correctly, place it on test, perhaps with the generator feeding into the aerial circuit, and wait for trouble.

TWO APPROACHES

When it occurs, one attempts to measure the sensitivity of each stage again in the hope that this will reveal the faulty one. It normally, will, too, if the fault remains stable long enough for you to complete your measurements, but unfortunately, it seldom does. There are now two possible approaches. The above procedure may be repeated, or, if the fault is so touchy that it seems unlikely that any satisfactorily measurements can be made, the signal may be fed into, say, the grid of the IF valve in an attempt to establish whether the fault is in the remainder of the set from there on.

In this case the faulty section is no longer under test so that prolonged testing will reveal nothing. This may be taken to indicate that the fault is not in this section, or it may indicate that it has decided to take time off for a while—not an unusual happening, I might add.

Thus the whole situation is most indefinite because, while the fault may have occurred several times, there is no means of knowing this, and its occurrence can only be assumed on the law of averages.

When using a signal tracer the signal is passed through every part of the set, irrespective of the section under observation, so that every time the fault occurs this is clearly evident and the performance of each section, as it is tested, can be related to the performance of the set as a whole.

How does the signal tracer work? It is really a receiver, usually of the TRF variety, which has been modified to allow it to be connected to the receiver under test and from which it picks off a portion of signal, treats it as would a normal set, and delivers it to a loudspeaker for observation.

Well, that's a rough idea anyway. Actually, there are quite a number of refinements which are normally regarded as essential if the unit is to really justify its existence. All of which simply poses the question, "What kind of tracer does a professional serviceman need?"

As with most of the other instruments we have discussed there are simple low cost devices, which are perfectly satisfactory for experimenters and part-time workers, but which hardly come up to the requirements of a full-time organisation. This applies not only to ready-made types, but also to numerous published designs, particularly in overseas periodicals, and which usually consist of one two "tubes" in a very simple circuit.

CIRCUITS

A popular arrangement is a leaky grid detector followed by a power output valve driving a small speaker. By careful design of the detector circuit, it is possible to feed it with both RF and AF signals, the valve working as a straight detector for the former, and as an audio amplifier for the latter. Quite obviously this is a compromise arrangement, and if the valve is adjusted to work as an efficient detector it is not capable of handling anything but the weakest of audio signals without distortion.

The input stage is not tuned, simply accepting whatever signals are present in the circuit under test. This is something of a disadvantage when it is desired to know if the frequency of signals in a certain part of the set is correct. This applies particularly around the converter stage, the plate circuit of which can supply signals at the frequency of the incoming signal as well as the sum and difference frequencies produced by the local oscillator.

Due to the nature of the input circuit it normally imposes a severe loading effect on the circuit under test, and in the hands of the inexperienced this can lead to misleading results. If the coupling between the tracer and the set is reduced, there is every chance that there will be insufficient signal to give a useable indication on the tracer.

All of which is simply leading up to what a good tracer should do. Firstly, it should have sufficient sensitivity to operate from the aerial terminal of the receiver and should also have some means of reducing sensitivity when higher level signals are being observed. Though not essential, it is helpful if the amount by which it is reduced can be indicated in some way.

Secondly, it is desirable that a tuned circuit follow the input so that the frequency of the signal being observed may be determined, at least approximately. This means that the unit must cover not only the broadcast band, but the IF and shortwave bands as well. Although simple designs sometimes extend the broadcast band to cover the popular 455 kc IF channel, by switching an extra condenser across the tuned circuit, this does not cover the older 175 kc channel and a better arrangement is a separate tuned circuit covering both frequencies.

For the shortwave section it is doubtful whether more than one band, covering the popular 16 to 50 metres, is really necessary, especially as it may increase the complexity and cost considerably.

LOW LOADING

Thirdly, the loading imposed on the receiver should be the lowest possible minimum. This means that the coupling must be extremely light and means, in turn, that considerable gain is required to make use of the very small signal fed to the tracer. Whether a single stage of RF amplification can be made sufficiently sensitive is doubtful, although the higher gain of the latest valves may be helpful, but for best results it is usual to use two such stages in conjunction with a two-gang condenser, the first grid circuit being untuned.

Your location, relative to transmitters, also has a bearing on the gain required in the tracer. In the metropolitan area the situation is not quite so difficult as in country districts and it may sometimes be possible to modify standard designs with some saving in cost and complexity. On the other hand the country dweller will have to consider his design with care to ensure that it has enough gain. The idea that a sufficiently powerful signal can always be created with the oscillator is apt to be misleading, for it is often desirable to check for elusive forms of distortion, and, barring a lot of complicated equipment, the observation of an ordinary program is about the most satisfactory approach.

Finally, it is usual to provide some means of metering the strength of the signal under observation, the simplest arrangement being an output meter connected across the speaker, but more usually takes the form of a VTVM, which can be switched to various parts of the tracer as well as being made available for external use.

USE OF VTVM

Its main purpose, apart from measuring the actual output of audio signal strength, is to measure the RF voltage within the tracer, which should normally remain constant regardless of modulation. This is an essential feature, when using a station as a source of test signal and is usually achieved by measuring the voltage developed in the detector circuit.

Should you buy or build your tracer?

There is no real reason why you should not build your own, for the parts required are all perfectly standard, and, in many cases, useful

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Initial appointments will be to Sydney Radio, but officers may later be required to serve at northern stations. District allowances at non-metropolitan stations vary between £15 and £175 per annum and are additional to salary. Penalty rates are paid for shift work, week-end and holiday duty. There are staff cottages at Papua-New Guinea stations and non-metropolitan stations in Australia.

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items may be salvaged from the junk box. The fact that they may not be as modern as current types is of little importance, the selection of a suitable circuit design being of prime importance.

Unfortunately, there are not a great number of such designs available, which is one reason why I have tried to cover as many aspects of the subject as possible for it is quite likely that you will have to do a certain amount of design work on your own account. This should not be beyond the scope of anyone who considers he is good enough to tackle the servicing of sets, particularly if he is given some idea of what are the major requirements and probable pitfalls.

COST

On the other hand you can buy signal tracers, and good ones, too, if you can manage the outlay. A really good one won't leave much change out of £50, but the cheaper types are hardly a proposition for full time work, which really means that either buy an expensive one or build your own. The final choice will probably depend on which you have most to spare, time or money. (Who ever heard of anyone having money to spare, anyway!)

For my case this month I have selected a little problem of ignition interference in a car set. Such problems can really be divided into two classes, the first where the trouble occurs in a new installation and the second where it suddenly develops in what has been a quiet installation.

This one came into the second category. In such a case one is reasonably safe in assuming the fault will be of a fairly definite nature since all the horrible intangibles which beset a new installation, will already have been ironed out. However, there are exceptions. One of these is the faulty bonding which occurs between various parts of the chassis and body due to the slow, but inevitable penetration of moisture and dirt.

OLD CARS

I am given to understand, by one who installs such sets for a large manufacturer, that old cars are always regarded as a bad risk in this matter of ignition noise due solely to the poor bonding which develops over the years.

While on the subject I asked him what standard of quietness was normally expected from a commercial set when properly installed.

"With a modern car," he said, "we normally expect that there shall be no audible ignition noise when the set is tuned between stations and the volume control fully advanced."

"I will admit," he hastened to add, "that this standard is not always achieved some cars being more difficult to suppress than others, probably due to variations in bonding, but we do keep fairly close to it, and ignition noise should never interfere with even a distant station which is worth listening to. Any suggestion of noise on a local station should not be tolerated in any circumstances and suggests a really serious fault."

Thus, it was that I approached the problem with a certain amount of reserve. As far as I could determine from the owner the onset of the trouble had been quite sudden, but he found it difficult to be too definite on this point, saying that it seemed to be worse in some locations than others, and that it was hard to say just when he had first found it to be really severe.

A quick check showed it to be very bad, much worse than the owner had led me to believe, which only goes to show how bad a set can be before some people will realise that anything in wrong. So bad was it that the noise was clearly audible even when tuned to a powerful local signal. Although I had little idea, at this stage, what the trouble might be, the fact that it was so bad did serve to confirm that it would be of a very definite nature.

First I checked the more obvious points, such as the connection between the main receiver mounting bolt and the car frame, and that no one had tampered with any of the normal suppression devices, but everything appeared in order.

Then, with the engine idling and the speaker popping merrily, I unplugged the aerial. The noise stopped immediately. Well, that was something, anyway, for it meant that the interference was reaching the set through the aerial rather than the battery line or the chassis return path.

AERIAL LEAD

Although the set appeared normally sensitive I checked the aerial lead for continuity. An open circuit here will not necessarily prevent the set from working, for there will still be some capacitive coupling and the high gain of a car set will usually allow satisfactory operation from local stations at least. But the signal strength will be seriously reduced relative to the amount of noise being picked up by that portion of the lead still connected to the set (and there will be some pick-up, no matter how well it is screened), thus giving a poor signal to noise ratio. But it was not so in this case, the lead was intact, and I realised I would have to seek further.

Next, with the aerial still unplugged, I checked for continuity between the aerial lead screening braid and the frame of the car. Normally, this lead, as well as being connected to the frame of the set, should be bonded to the frame of the car at the opposite end. In this case there was no indication of continuity, even when using the high ohms range, and I began to suspect that this was the trouble.

AERIAL

The car used an under running-board type aerial, and I spent the next ten minutes on the broad of my back, digging into many years' accumulation of mud, most of which seemed to finish up in my eyes and ears. Anyway, I eventually laid bare the spot where the aerial lead joined the aerial proper, and also where the outer braid was supposed to connect to the frame. Actually, this latter appeared to be intact, the braid being wrapped around a convenient chassis bolt and firmly clamped under a nut and washer.

However, the ohmmeter once again revealed that there was no continuity, even between these two pieces of metal which appeared to be in perfect physical contact. A spanner from the car's tool box, coupled with much heaving and grunting, eventually succeeded in freeing a very stubborn nut, revealing just exactly what one would expect in the circumstances—a layer of rust on both the frame of the car and the clamping washer, which effectively insulated them from the braid.

I cleaned the rusted metal around the bolt, which was no easy task in the spot in which it was located, using the blade of a screwdriver, a file, and some coarse steel wool. When I eventually had it to my liking I felt sure it would offer no appreciable resistance for the time being, but it seemed to be only a matter of time before the same thing happened again. I managed to find a brass washer to replace the steel one, there being very little left of the latter when the rust was removed, but there was little I could do about the nut, it being a thread peculiar to the car, and unlikely to be available in brass.

EARTH BRAID

In any case, it is doubtful whether it would have been much help, except when it had to be removed again, since the connection had eventually to be made to a steel surface (ie, the frame of the car) and there appeared to be little that could be done to prevent it rusting in such a location.

The braid itself also needed some attention. Being tinned copper it had not rusted, but the rust from the steel surfaces had penetrated between the individual strands. Most of this was removed with the aid of a toothbrush soaked in methylated spirit and then the whole arrangement was reassembled. An ohmmeter check now showed no measurable resistance even on the lowest range, and when the set was switched on and the engine started, the noise had vanished completely.

Finally, in an effort to put off the time when such attention would again be needed, I covered the joint with a coat of paint, endeavoring, as far as possible, to close all the spots which might allow the entry of moisture and dirt. Just how effective it will be in twelve months is hard to say, but at least it was better than nothing.

LEAD BONDING

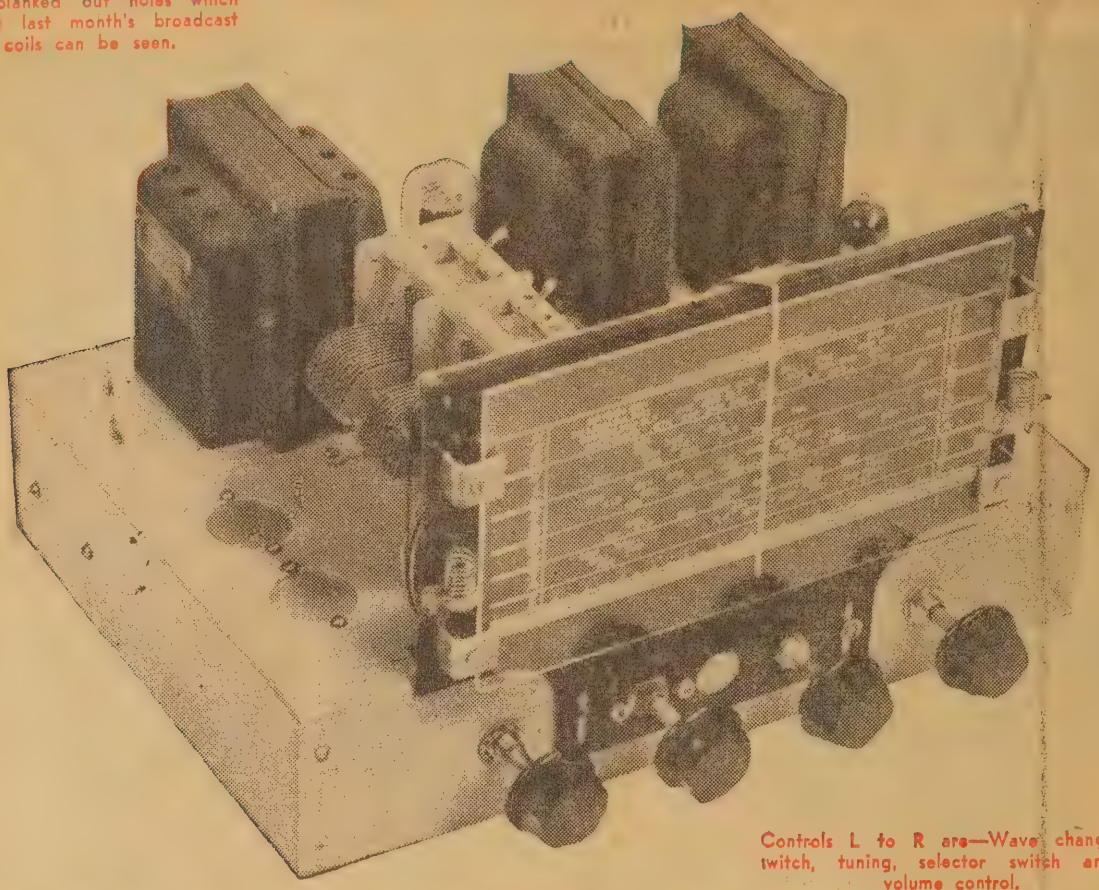
There are two points which emerge from this experience. One is that this bonding of BOTH ends of the aerial lead is essential if freedom from ignition noise is to be complete, and, I am given to understand, this is where most amateur installations fail, many chaps being unable to understand that a low DC resistance does not necessarily mean a low impedance at the radio frequencies involved.

The other point is that under the running-board is about the worst possible place for an aerial. It is impossible to protect it adequately, and, when the weather is wet, it is subject to a continual bathing of mud and slush thrown up by the front wheels. Also the clearance from the frame of the car can only be a few inches at the best, and can in no way compare with the vertical type, part, at least, of which is well clear of the car frame.

This, then, is the price you pay for the rather doubtful privilege of not being able to show off to your neighbors that you can afford a car radio.

No wonder they are no longer popular!

The blanked out holes which carried last month's broadcast coils can be seen.



Controls L to R are—Wave change twitch, tuning, selector switch and volume control.

DUAL-WAVE ADVANCE 1952

This receiver is the dual-wave version of the 1952 ADVANCE described last month. The conversion to dual-waves is about as simple as it can be, but just to keep the description complete the set is treated as though you were starting from scratch. It is a particularly fine performer—the nicest dual-waver of its size we have built to date.

by John Moyle

WHEN building a set few things are more annoying than the necessity to refer to an article which appeared last month and which, for the moment at least, you can't for the life of you locate!

There is so little difference between the broadcast and dual-wave versions of the Advance that there is a good deal of duplication in treating them as separate, complete articles. However they are both such good receivers, and likely to be so popular, that we don't apologise for devoting the space to them in both versions.

DESIGN FEATURES

The Advance, you will remember, was designed to include all the wanted features in a standard receiver of today. Without using more gear than was necessary, it had to give good all round performance as a straight set, and as a radiogram, provide the pre-amplification and compensation needed to play modern micro-groove records at the turn of a switch.

Just to give good measure, we added a variable selectivity feature which gave a wide-range listening position as well as a normally-selective setting. As record compensation provided for 78 British and American as well as micro-groove, there are five positions on the selector switch giving instant change to any one of them.

Using high-gain miniature valves, splendid performance is obtainable without the use of an RF stage, thus making the set a 4/5 type.

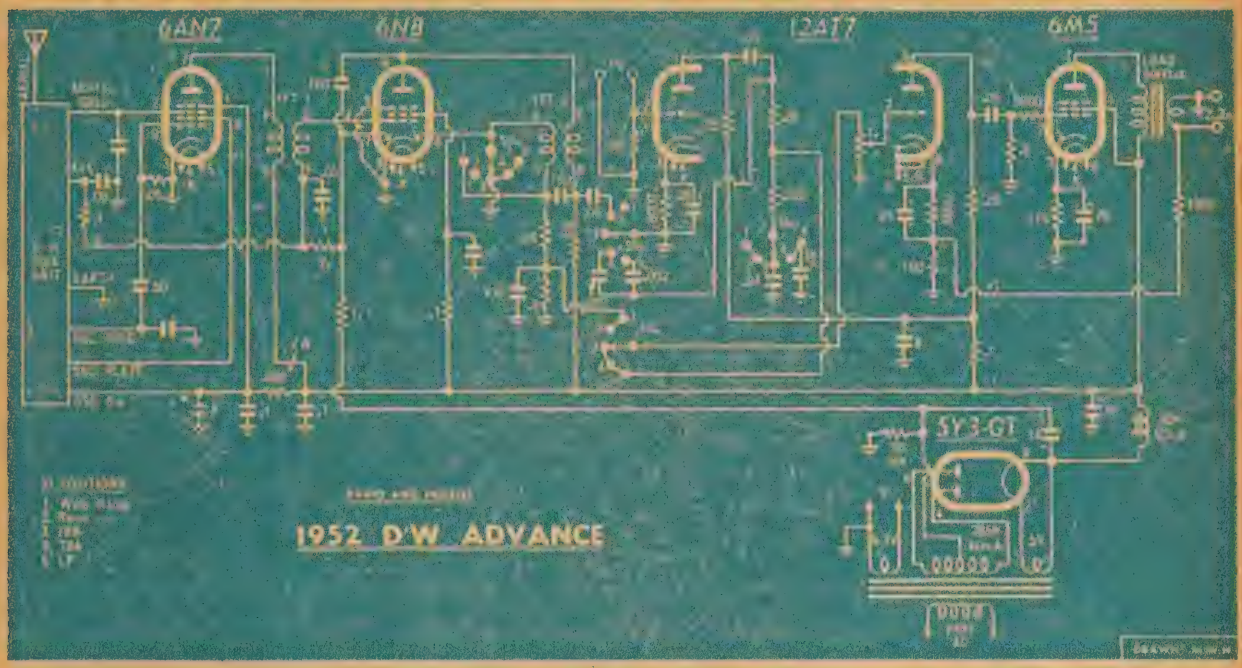
The converter is a 6AN7, and the IF amplifier a 6N8. This valve also operates as a diode detector and provider of AVC voltage.

From this valve, output runs to one half a 12AT7 double triode which is once again available in reasonable numbers. This half-triode section feeds the output valve—a high gain 6M5. The 5Y3-GT rectifier completes the valve complement.

The first half of the 12AT7 is used only in the pick-up circuit, and apart from a small amount of gain, it gives the various degrees of compensation needed for the different types of records.

This record compensation is quite necessary with modern pick-ups. Even the crystal types will benefit from compensation, and this receiver

CIRCUIT DIAGRAM OF DUAL-WAVE ADVANCE



The circuit is not essentially changed from last month, except for the tuning coil assembly.

will accept the input from either light-weight crystal or magnetic pick-ups and play just as well with either. There is ample gain in the gramophone position to give all the volume you could wish for up to a maximum of about 4 watts.

WIDE RANGE TUNER

The addition of the wide-range radio position makes this receiver quite unique, and probably superior to any other of its size available today. And yet these features are included without complications or a large array of components.

The variable selectivity circuit, for those who have not seen it before, is an idea of our own in which the first IF transformer is replaced by switching with a simple resistance-coupled circuit having less gain and also less selectivity. The band-width of the receiver is noticeably widened, but not enough to bring the selectivity down to the level of a straight TRF set. But it is quite enough to make a big difference when receiving high-grade programs with good high note response.

The ordinary superhet, as represented by this set in its "normal" position, has fairly severe side-hand cutting inherent in its design. As a result, high note response on radio is severely restricted.

BIG IMPROVEMENT

Eliminating one of the transformers in favor of the resistance coupling doesn't give anywhere near a flat response over the audio band, or even as wide a response as can be obtained with a good TRF set. But there is no mistaking the improvement it does make. It would be hard to devise any way of improving our results in this regard without abandoning the superhet circuit altogether or making the set too complicated for the home builder.

As it is, we have a useful combination of normal and wide-band listening, at the same time keeping the essential superhet circuit which is a "must" if we are to use a dual-wave bracket for short wave reception.

As mentioned last month, do not make the mistake of looking at the switching of the circuit and passing on with a sigh that the set would be "too hard" for you. It isn't anything of the kind.

By taking care with the layout, the two-band 2 x 5 switch is mounted strategically so that all the leads to and from it are short. It is no harder to connect these leads to switching points than it is to any other points in the circuit. In the diagram, leads seem to run to the switch from widely scattered points. But in practice, these points are all grouped quite closely together. Just study the circuit for a while, until you find your way about it, and you'll suddenly realise that the switch has fooled you!

The whole secret in wiring these switches is to find out by inspection which way the switching runs. There are four main connecting points to the switch, two for each bank. Each of these four points connects to five others as the switch is rotated. By watching the contacts as the switch is operated, you can see quite clearly which group of five belongs to each main common point. If you have on ohm meter or continuity meter, you can verify your observation by checking the operation of the switch. All this is easy stuff and well within the grasp of the average schoolboy.

When the switch is in place, spend a few minutes visualising how the wires will run to it. You'll find it

PARTS LIST

1 Chassis (Advance 1951).
1 Tuning dial.
1 2 gang tuning condenser.
1 2 bank 2x5 switch.
1 D/W coil bracket.
2 455Kc I.F. Transformers (Nos. 1 and 2).
4 Noval sockets—1 octal socket.
1 Power transformer, 285V at 80 mills, 6.3V, 5V.
1 80 mill, 30H Filter Choke.
1 Output transformer, 5000 ohms to V.C.

VALVES—6AN7, 6N8, 12AT7, 6M5, 5Y3.

CONDENSERS—
2 16mfd 525V electrolytics.
1 8mfd 525V electrolytics.
3 25mfds 40V electrolytics.
3 .1mfds 400V.
5 .05mfds 400V.
1 .04mfds 200V
1 .02mfds 200V.
1 .002mfds mica.
1 .001mfds mica.
3 100pf mica
1 50pf mica

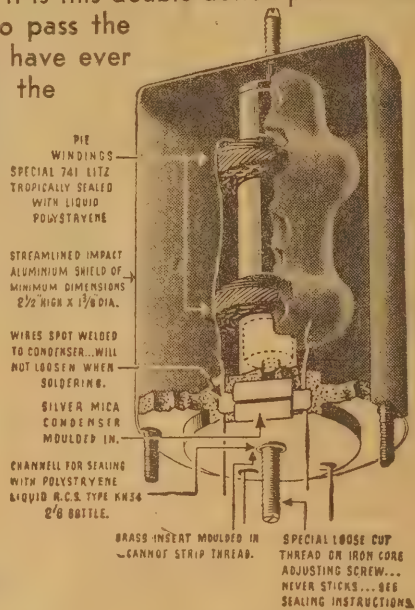
RESISTORS—
1 1 meg pot.
1 2 megs
1 1 meg
2 .5 megs
3 .25 megs
2 .1 megs
3 50,000 ohms
2 25,000 ohms
1 20,000 ohms
3 5000 ohms
1 1000 ohms
1 175 ohms 5W
1 100 ohms
1 30 ohms 5W

Speaker plug and socket, terminal strips, four knobs, power flex, nuts, bolts, four terminals dial lamps, hookup wire, etc.

THE STORY OF...

THE TWO-FACED COIL

Every R.C.S. coil has two protective faces—that means double protection against loss of performance under any operating conditions. The exterior face—the outer aluminium shield—protects the coil from outside interference; the inner face—an impregnation of liquid polystrene—guards the wiring, moulded-in condensers and coil ends against drift due to moisture penetration and extreme climatic changes. It is this double action protection that enables the R.C.S. coil to pass the most rigid tests to which coils have ever been submitted — including the well-known immersion test. This laboratory test imposed upon the R.C.S. I.F's. conditions far in excess of those which they will encounter anywhere in the world.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STREAMLINED IMPACT ALUMINIUM SHIELD OF MINIMUM DIMENSIONS 2½ HIGH X 1⅜ DIA.
WIRES SPOT WELDED TO CONDENSER...WILL NOT LOOSEN WHEN SOLDERING.
SILVER MICA CONDENSER MOULDED IN.
CHANNELL FOR SEALING WITH POLYSTRYENE LIQUID R.C.S. TYPE KN36 2/6 BOTTLE.
BRASS INSERT MOULDED IN CANNOT STRIP THREAD.
SPECIAL LOOSE CUT THREAD ON IRON CORE ADJUSTING SCREW... NEVER STICKS... SEE SEALING INSTRUCTIONS.

R.C.S.—for over a quarter of a century

Mere chance did not produce coils and I.F's. with such a high "Q"—the result of twenty-five years of detailed research and up-to-the-minute advice of the latest overseas developments made this possible. This is your guarantee of peak performance whenever you use and install R.C.S. components in your circuits.

EXAMINE THIS LIST OF R.C.S. COILS FOR YOUR NEEDS

INTERMEDIATE TRANSFORMERS

STANDARD 455 Kc/s
ROUND CAN DIMENSIONS
2½" x 1⅜"
IF170 1st Stage Per'tune Iron Core.
IF171 2nd Stage Per'tune Iron Core.
IF172 1st Stage Per'tune Iron Core.
IF173 2nd Stage Per'tune Iron Core.
IF174 Low Gain Per'tune Iron Core.
STANDARD 175 Kc/s
SQUARE CAN DIMENSIONS
3" x 1⅜"
IF162 1st Stage Per'tune Iron Core.
IF163 2nd Stage Per'tune Iron Core.
IF164 Low Gain Per'tune Iron Core.
MAGNASONIC 455 Kc/s
ROUND CAN DIMENSIONS
2" x1"
IF168 1st Stage Per'tune Iron Core.
IF169 2nd Stage Per'tune Iron Core.
STANDARD 175 Kc/s
SQUARE CAN DIMENSIONS
3" x 1⅜"
IE74 1st Stage Per'tune Iron Core.
IE75 2nd Stage Per'tune Iron Core.
F.M. TYPE
IF180 10.7 Meg. Iron Core Permatune.
IF181 Ratio Detector Iron Core Permatune.

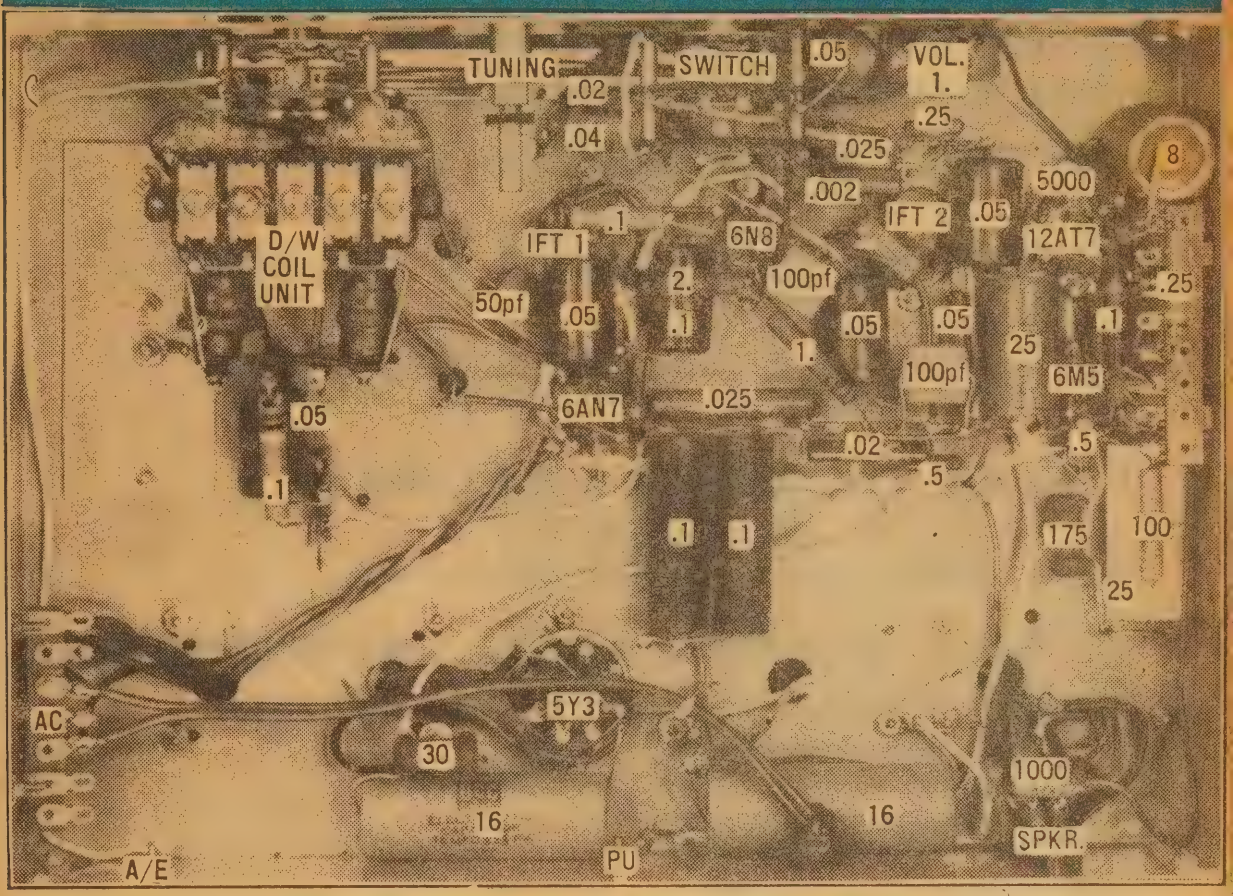
COILS

STANDARD SUPERHET BROADCAST
ROUND CAN DIMENSIONS
2" x 1⅜"
E356 Iron Core Permatune Aerial.
E357 Iron Core Permatune R.F.
E358 Iron Core Per'tune Oscillator.
STANDARD SUPERHET BROADCAST
SQUARE CAN DIMENSIONS
2⅜" x 1⅜
E342 Air Core, Aerial.
E343 Air Core, R.F.
E344 Air Core, Oscillator.
E345 Iron Core Per'tune Aerial.
E346 Iron Core Permatune, R.F.
E347 Iron Core Per'tune Oscillator.
MIDGET MAGNASONIC BROADCAST
ROUND CAN DIMENSIONS
1" x 1"
E352 Iron Core Per'tune Aerial.
E354 Iron Core Per'tune Oscillator.
E353 Iron Core Permatune, R.F.
F.M. COILS
E362 Aerial.
E363 Aerial Coupling.
E364 Oscillator.
T.R.F. COILS
T81 Air Core Reinartz.
T82 Air Core Reinartz in Can.
T87 Air Core R.F. with Reaction
T88 Air Core Aerial.
T89 Air Core, R.F.
SHORT-WAVE COILS
H121 Iron Core Per'tune, Aerial.
H122 Iron Core Permatune, R.F.
H123 Iron Core Per'tune Oscillator.
LOOP AERIAL COILS
F125 Standard 6" Diameter.
F126 Midget 4" Diameter.
5-BAND SHORT-WAVE AND BROADCAST
H124 10 Metre Aerial.
H125 10 Metre R.F.
H126 10 Metre Oscillator.
H127 20 Metre Aerial.
H128 20 Metre R.F.
H129 20 Metre Oscillator.
H130 40 Metre Aerial.
H131 40 Metre R.F.
H132 40 Metre Oscillator.
H133 80 Metre Aerial.
H134 80 Metre R.F.
H135 80 Metre Oscillator.
H136 Broadcast Aerial.
H137 Broadcast R.F.
H138 Broadcast Oscillator.
COIL KITS
K116 Standard Personal Coil Kit.
K117 Standard 4/5 Dual Wave Kit (Complete with Intermediates).
K118 Midget Personal Coil Kit.
K119 Midget B/C Coil Kit.
K120 5 Band Coil Kit.
K121 4/5 B/C Coil Kit.
K122 5/6 B/C Coil Kit.
LINE FILTER COIL
RF15 Line Filter Coil ¾ Amp.

R.C.S. RADIO PTY. LTD.

R.C.S. RADIO PTY. LTD., 651 FOREST ROAD, BEXLEY. LW3491

UNDER-CHASSIS LAYOUT OF DUAL-WAVE ADVANCE



Nearly all the components under the chassis are visible in this picture.

easy to work out the best sections to use for each of the four functions.

There was quite a bit written in last month's article on this point, and you would be well advised to look it up to help make this matter even clearer.

INVERSE FEEDBACK

In the audio section, inverse feedback is used from the voice coil winding of the output transformer into the cathode circuit of the second triode section. It as almost essential therefore, to mount the output transformer on the chassis, otherwise oscillation may easily occur.

This type of mounting is good, anyhow, because with a good set it's worth buying a special high-grade type of speaker transformer available from any radio store in several different makes. The standard type has a range substantially flat from 50-10,000 cycles, and for something extra you can buy even better transformers than this. This set rates a good 12in speaker, and such speakers today are rarely sold with transformers. Manufacturers invariably rely on transformer specialists to supply them.

REDUCED DISTORTION

Incidentally, if you connect the transformer the wrong way around, you will get a terrific howl instead of music. This is because you'll be supplying positive instead of negative feedback.

The feedback circuit allows for about 15 db of feedback. This reduces distortion to a very low figure, and output impedance also drops by a considerably greater amount. It is not really worth using a greater degree of feedback in this circuit.

The receiver is built on the same chassis as is used for the 1952 Advance Radiogram, broadcast version, which was in its turn, the same or almost the same as that for the 1951 Advance. The space occupied by the broadcast coils in last month's set is now used for a dual-wave coil bracket.

Correction!

IN last month's 1952 Advance, the padder condenser was wrongly shown as .004 mfd. This should be .0004 mfd. The exact value is .000425 mfds, but this is not always easy to obtain. Sorry for the mistake! Fortunately the padder is a standard value, and the error is rather obvious.

In making the conversion to dual-waves, it was simply necessary to remove the connections from the broadcast coils, mount the dual-wave bracket in place, and reconnect the leads to it instead of to the broadcast coils. It wasn't necessary to lengthen any leads except that to the aerial grid, and one or two of the others were shortened.

The AVC decoupling condenser and resistor were still mounted on the same little terminal strip at one end, the other being soldered direct to the coil unit. The entire change-over occupied about half an hour, and the set worked when first switched on after the change.

The coil unit mounts in the hole previously occupied by the tone control which, in any case, was included largely to balance up the controls.

The coil kit shown is an RCS, but other well-known coil units made by Q-plus and Aegis can be used with equal success. The mounting is slightly different, but they all work out about the same constructionally, despite their difference in shape.

We had to leave off the flywheel on the dial spindle to avoid fouling the coil unit. If, however, you mount the unit on a bracket, and set it back from the front edge of the chassis, you will not only make room for the flywheel, but actually shorten the leads to the unit, which is a good thing. The spindle may need to be lengthened by using an extra piece of rod and a coupling device to join the two together. This is quite an easy job, and there is still ample room for the coil unit.

In fact the accessibility of the set, and the extreme flexibility allowed by the layout, is one of its most attractive features.

No trouble was experienced in lining up the coil unit or in getting really excellent short-wave reception. Lining up the unit isn't really hard, and in a separate article in this issue we have given detailed instructions how to line up all the popular makes of coil brackets.

if you have decided to build the "PLAYMASTER BABY" AMPLIFIER which is featured in the December issue, the following Ferguson Transformers suit the requirements of the circuit.

POWER TRANSFORMER, TYPE PF151A

Primary Volts 200, 230, 240.
Secondary Ratings 285V aside at 60 mA. 6.3V at 2A, and 5V at 2A.
This Transformer is upright mounting, finished in a pleasing black brocade.

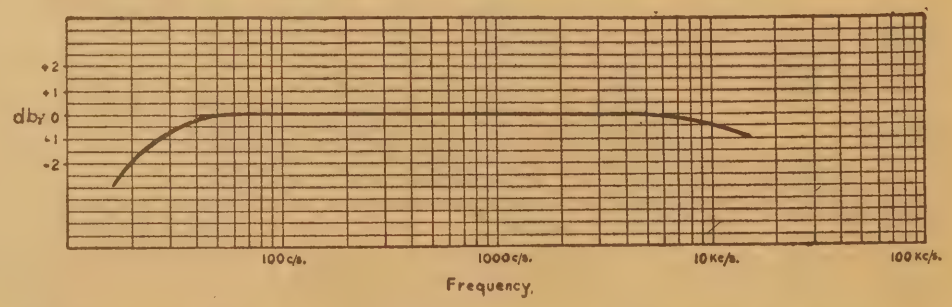
FILTER CHOKE, TYPE CF103

Inductance, 30 henries at 60 mA DC.
This Choke is designed for the power Transformer above.

OUTPUT TRANSFORMER, TYPE OP24/15

Primary Impedance 5000 ohms S.E. Max. Power 6 watts.
Secondary Impedance 15 ohms.
A feedback winding is incorporated for use if required.
The frequency response is flat within 1 decibel in the range 20 to 15,000 cycles per second. The response curve for this Transformer is shown below.

FREQUENCY RESPONSE - OUTPUT TRANSFORMER TYPE OP-24/15.



Also in the December issue is the "JUBILEE PORTABLE," suitable for Battery or AC operation for which the following Ferguson Types are suitable.

POWER TRANSFORMER TYPE PF201

Primary Volts 240
Secondary Ratings 225V aside at 50 mA, 6.3V at 2A, and 5V at 2A.

FILTER CHOKE TYPE CF102. Inductance 15 henries at 60 mA DC.

-FERGUSON- **TRANSFORMERS PTD. LTD.**

Ferguson Lane, Chatswood. Phone JA2878.

The set isn't at all hard to build, and there are no special snags to look for. We took care when mounting the valves and IF transformers to see that the plate and grid leads were as direct and short as possible, and that they were well separated. This is normal precaution to avoid instability in the IF section. You'll find by experimenting before wiring up that you can arrange sockets and coils quite easily for these short connections.

It is not absolutely essential that the components should be mounted exactly where we have them. In fact, there are some mounted one above the other near the terminal strip at the right hand side, which can't be shown at all. The photograph is intended merely as a guide, and if you mount your parts somewhere near the mark, it may help to get the same results as we did, and may keep you out of trouble.

SOLID SUPPORTS

Do make sure, however, that all the components are solidly supported, using those handy little terminal strips that come in various sizes, and be careful to make sure that the connections to the chassis are really in contact with it. Lock-nuts and solder lugs screwed down under a handy bolt are good. Don't be afraid to drill a special hole for an earth point if you can shorten the lead or clean up the wiring by so doing.

In the circuit diagram we have shown an 8 mfd condenser from oscillator B plus to the chassis. This is often a good thing to increase stability particularly on short waves, although it is not always required. If you have such a condenser handy, by all means wire it in.

If you use a 15 ohm speaker, you will need to increase the value of the 1000 ohm feedback resistor to 3000 ohms. This will provide approximately the same degree of feedback as the present circuit does for 2.3 ohms. If your speaker is an 8 ohm voice coil type, 2000 ohms will be about right.

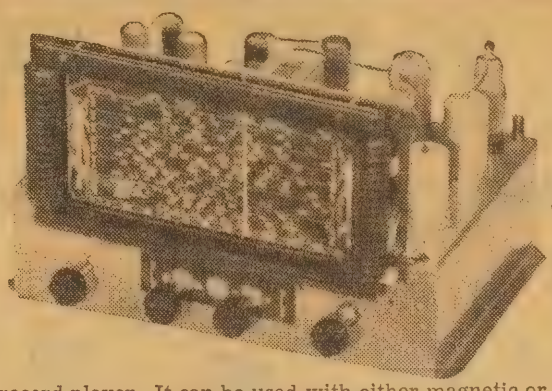
There is nothing magical about this resistor and a few ohms either way won't matter very much. The exact amount of feedback isn't critical as long as there is enough.

Incidentally, referring for a moment to last month's broadcast-version we showed a tone control in the photographs, but did not indicate in the circuit where it was to be wired! It was really added as an afterthought merely to balance up the front of the chassis, although you may as well have it there.

Actually, it is wired from the plate of the second section of the 12AT7 to the chassis, and will give a little top cut when required. You can vary the value of the condenser to please yourself, making it larger for more top cut, and smaller for less.

The photograph showed a .004 condenser mounted next to the 1 meg. control. We changed our minds about the circuit after the picture was taken. You should use a condenser value of .05 mfds of 400 volt rating or higher. With the 1 meg. control this will operate on both radio and records.

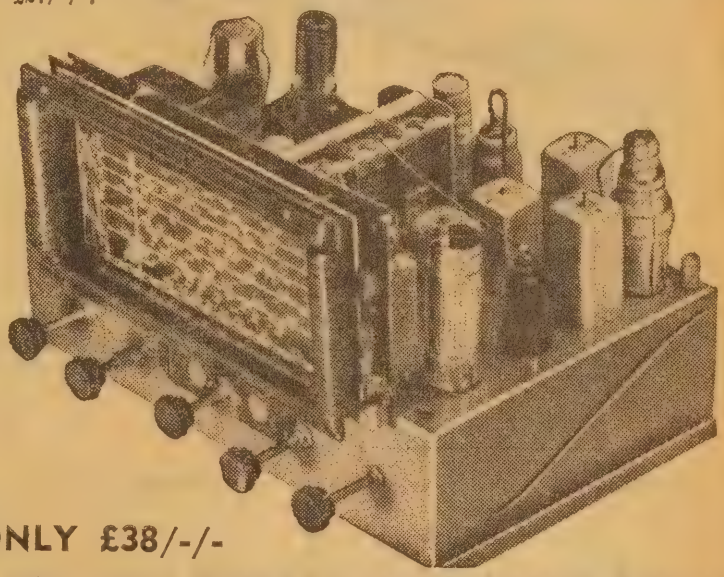
This is a really good receiver. When you have it finished and lined up it should be the equal of all but the very biggest radiograms, and has some features which cannot be found in any receiver you can buy.



5 VALVE DUAL WAVE RADIO CHASSIS

Complete with 8" speaker and five valves.

This 5-valve dual wave chassis is suitable for use in a radiogram, and is fitted with pick-up terminals ready to be attached to a record player. It can be used with either magnetic or crystal pick-ups, and is supplied complete with escutheon plate for the large, edge-lit, clearly marked dial. Price £25/-/-. Size 15" x 10" x 9½" high. Valves used: ECH33B, 6SK7G, 6SQ7G, 6V6G, 5Y3G. Supplied with 12" speaker in lieu of the 8". £27/-/-.



ONLY £38/-/-

FOR THIS 8-VALVE DUAL WAVE RADIO

Here's value only to be found at Radio House Pty. Ltd. This ready-made and tested chassis is complete with valves and 12" permagnetic speaker. Complete in every detail, it's easily fitted into your radio cabinet and can be supplied with a polished wood front panel. Ideal for overseas short-wave reception. fitted with phono pick-up terminals, and has tone controls for treble and bass boost.

Valve types and functions:

6SK7—R.F. Pentode
ECH35—Mixer Valve
6AR7—High gain I.F. and diode detector and A.V.C.
6SJ7—1st Audio Driver
6J5—Phase Changer
6V6, 6V6—Push-pull output to Speaker.
5Y3—Rectifier.

Dimensions: 16" x 10½" x 9" high. Weight when packed in crate: 63lb.

Front view with panel attached.

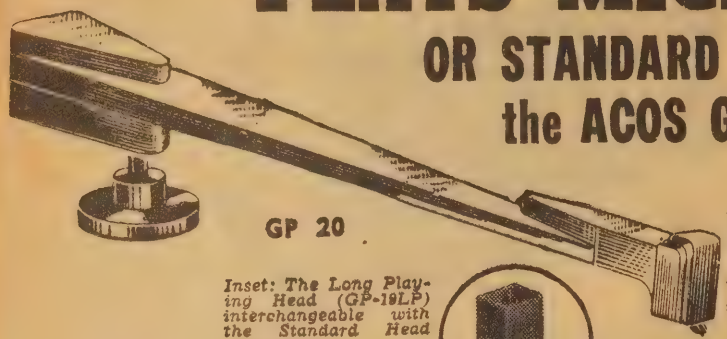
With 12" Permagnetic Speaker.

NOW AVAILABLE. "PLESSEY" 3 speed record changer £40/2/6 33, 45 & 78 RPM

RADIO HOUSE PTY. LTD.

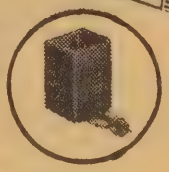
296 PITT STREET, SYDNEY.

PLAYS MICROGROOVE
OR STANDARD RECORDINGS
the ACOS G.P.20 Microcell Pickup



GP 20

Inset: The Long Playing Head (GP-19LP) interchangeable with the Standard Head (GP-19).



The G.P.20 pickup is designed for use with the standard 78 r.p.m. records or the 33 1/3 or 45 r.p.m. long-playing microgroove records. To meet these differing requirements, two interchangeable slide-on heads are available.

G.P.19 head supplied as standard.

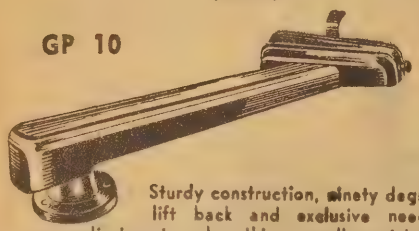
G.P.19 L.P. head available for microgroove.
It is something new in pickup design and has 20 times greater output than comparable magnetic types, while needle talk and motor rumble are practically non-existent —permanent sapphire stylus—wide frequency response.

Price—G.P.20 complete with standard head £6/3/6

Price—G.P.19 L.P. head £3/11/0.

Price—G.P.19 standard head £3/11/0.

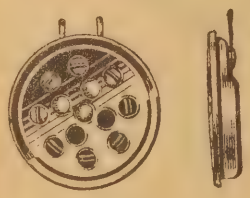
GP 10



Sturdy construction, ninety degree lift back and exclusive needle pressure adjustment makes this a really outstanding unit in the field of pickups. Has a low harmonic distortion, with an average output of 1.5 volts.
Price £3/2/9
Cartridge only (G.P.9) Price 36/9

G.P.11 Acos Pickup Cartridge incorporates permanent sapphire stylus. Replacement cartridge for ACOS G.P. 12 pickup and many American types. Useful frequency range 25 to 12,000 c.p.s.
Needle pressure only ½oz. 41/6

Choose your equipment from this famous range!



MIC 14

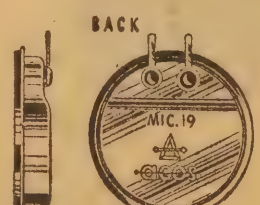
MIC 14 Standard Speech Microphone insert with nickel-plate brass case which gives high corosion resistance, mechanical strength and rigidity. Price 39/3.

MIC 18

MIC 18 Microphone Speech insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required this insert is recommended. Price 39/6.

MIC 3

MIC 3 Diaphragm-Actuated Crystal microphone specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity. Price 39/3.



MIC 19

MIC 19 Sintercel fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction. Price £2/19/9.

ACOS MICROPHONE INSERTS

Crisp, clear-cut reproduction and a host of technical features make ACOS Crystal Microphones the ideal choice for:

Public address: High output, light, yet rugged, may be adapted as a lapel mike.

Home Broadcasting: Exceptionally high gain allows direct use into pickup terminals.

Deaf aids: Used by all leading Deaf-Aid Manufacturers.

AVAILABLE FROM ALL RADIO STORES THROUGHOUT AUSTRALIA

(Sole Australian Representative)

(A'SIA) AMPLION Pty. Ltd

36-40 Parramatta Road, Camperdown, Sydney, N.S.W.

All prices subject to change without notice.

The slight increases in price are due to sales tax adjustment.

HOW TO MAKE AN ELECTRIC MOTOR

This, the fourth article on electricity for the junior experimenter, explains how some simple electric motors work. It also describes a working model electric motor which can be built from scrap parts in a single evening. A single torch cell will run the motor in grand style. Build it. You will add greatly to your store of practical knowledge of electricity.

IF you care to make a study of the history of electricity, you will note that many things were known about it before anyone succeeded in making a practical device for continuously converting electrical energy into mechanical energy. They had succeeded in converting mechanical energy and chemical energy into electrical energy long before the reverse was possible. Indeed, the first indication of this mysterious force came from the ancient Greeks who discovered that if pieces of amber were rubbed they had the power of attracting light objects.

ATTEMPTS AT MOTORS

We showed you how you could demonstrate some of the effects of electric charges in an article in the November issue. You will remember that the cork cube of the home-made electroscope exhibits uncanny properties when itself charged and/or brought under the influence of other electric charges.

No doubt, many of the early experimenters pondered over the problems of utilising the invisible forces of electric charges to operate machines. We know for certain that a system for sending messages over distances by electric charges was proposed.

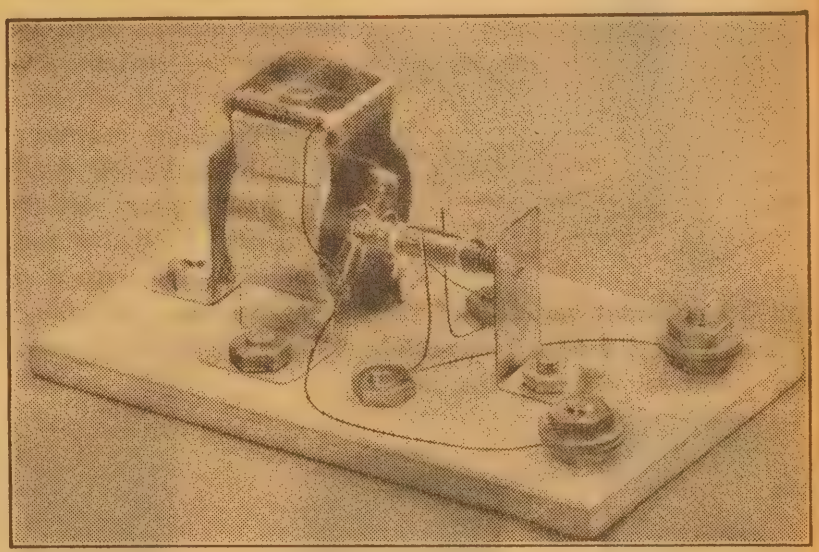
However, none of these schemes was successful to a worthwhile degree. Rubbing pieces of amber or other insulating material is a most inefficient way of generating electrical energy. Even when you have succeeded in generating the energy it is easily dissipated due to leakage through the air.

The key which opened to civilisation a store of practical use for electricity was found by a Danish scientist called Oersted. In demonstrating to some of his pupils the heating effect of an electric current he noted that the wires carrying the current influenced a compass needle in its vicinity. As you know from the earlier experiments, a compass is nothing more than a small magnet which is suspended so that it can easily align itself with the earth's magnetic field.

MAGNETISM THE SOLUTION

The earth itself is a huge magnet having a north and a south magnetic pole corresponding roughly with the north and south geographic poles. The tiny compass needle also has its own magnetic poles which are situated near its respective ends. One pole is attracted to the earth's north magnetic pole and repelled by the earth's south magnetic pole while the other behaves in exactly the opposite way.

The work of Oersted was later enlarged upon by a French scientist called Ampere who analysed the effects of the electric current in the wire in great detail. He gave a method for determining the shape and polarity of a field around a wire.



This is a full sized picture of the motor. No special parts are required and you can make it in a couple of hours.

While electrostatic attractive and replusive forces are difficult to produce and of limited strength for practical considerations, magnetic fields are relatively easy to produce, can be made of great strength.

You will remember having demonstrated the magnet field around a wire in an earlier experiment. We also showed how a number of wires could be so arranged that a very strong magnetic field is created.

ELECTROMAGNETIC PHENOMENA

The great advantage of this form of magnet is that it may be switched off and on when required. The buzzer described in last month's issue made use of such an electromagnet. As you will recall, a contact is arranged so that when the reed is attracted by the electromagnet, the circuit is broken. In turn, the electromagnet ceases to function so that the reed is able to spring back to its original position again completing the circuit. The whole action then repeats itself. the repetition occurs at a very high rate and the familiar buzzing sound is produced.

by Maurice Findlay

By a suitable mechanical arrangement the pull of the electromagnet can be converted into a continuous rotating movement. There are hundreds of instances on record of early attempts to make use of this idea. Some of course were no more than scientific novelties.

One of the first electric motors ever made was very like that shown in Fig. 1. The electromagnet coil is worked in series with a set of contact points arranged much after the same style as the buzzer. Of course, the parts are much heavier and the mechanism works very much slower.

One end of the lever is attached to a pawl which, in turn, works a toothed wheel. Each time the lever moves up and down the toothed wheel advances by one tooth. In practice, the toothed wheel may tend to turn in the wrong direction on the downward stroke of the pawl and a second pawl is required to prevent this. To make the motion smoother a heavy flywheel may be fitted to the same shaft as the toothed wheel.

EXPERIMENTAL MOTORS

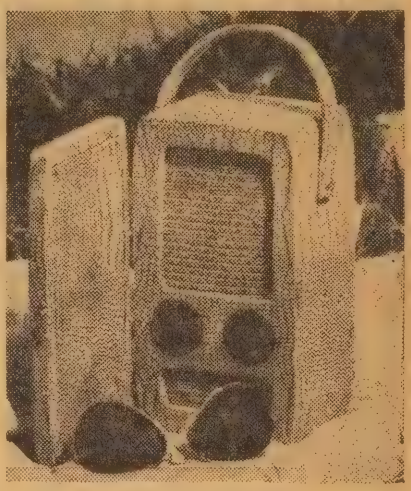
A motor very similar to this was used in airborne radio communication sets to operate an automatic tuning mechanism so apparently the idea is still a good one. Of course since the original, engineers have learned how to make efficient electromagnets so that the modern version is a reliable and efficient motor.

You can make one of these motors at home without too much difficulty. The main problem is likely to be the toothed wheel. Certain large clocks have wheels which would be suitable even if it proves necessary to solder

IDEAL COMPANIONS

FOR OUTDOORS...

Build your own portable as an ideal companion for those out of doors jaunts. Electronic Parts will supply you with a complete Kit for any of the sets illustrated on this page, all of which use tried and tested circuits. Each Kit contains everything necessary for building the set — all first quality parts, and as specified by "Radio and Hobbies." There are also over 50 different varieties of radio Kits available, including A.C. sets, battery sets, gramo-comb., vibrator sets, 32-volt sets, etc. Send coupon for price list.



CARRY-SET

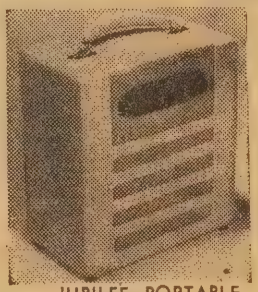
Smartest of all small portables. A 4-valver, extra simple to build and most efficient in action. Smartly streamlined cabinet makes it a pleasure to carry, and the size is only 8¼" x 4½" wide x 4" deep. Originally described in "Radio and Hobbies," October, 1949.

HANDIE TALKIE PORTABLE

("R & H" Dec., 1947). A 4-valve personal portable in cabinet measuring only 7" x 4½" x 5". Ideal for the beach, picnics, etc, and lowest cost of all the portables.

SENIOR PORTABLE

Originally described in "R. & H." for December, 1948, this 5-valve portable with R.F. Stage uses either 6" or 7" speaker. A kit of parts for an A.C. power supply is also available. Cabinet size of portable 12½" x 8¼" x 6¼".



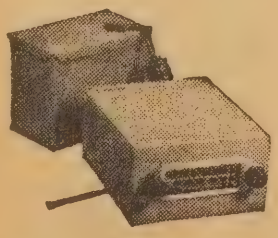
JUBILEE PORTABLE

("R & H" December, 1951). This latest "R & H" design features a 6 valve receiver with RF stage and built-in AC power unit in an attractive cabinet measuring 10" x 10½" x 6". Battery/AC changeover is effected by a single switch and the dial used is the latest Efco Midget straight line type.

SPRINGTIME PORTABLE

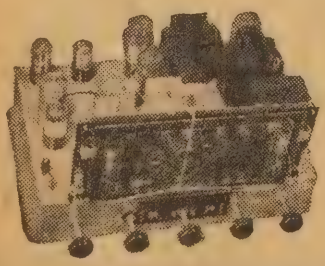
("R. & H." Oct., 1946.) A sturdy 5-valve portable with R.F. Stage which will take any amount of hard work. Cabinet size including hinged lid, 13" x 8⅝" x 5½".

. . . and for Car and Home



KAR-SET

A neat compact car radio, designed for 6 or 12 volt operation, it has 5 valves, but gives the performance of a six-valver, the strong metal box is finished in the latest sprayed brocade process, and the kit comes to you complete down to the last nut and bolt.



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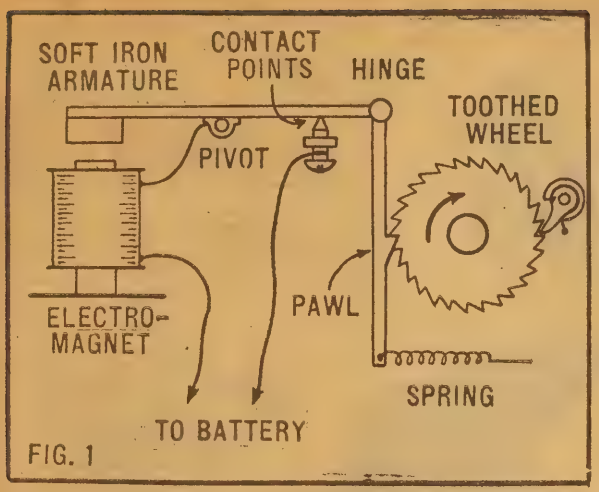
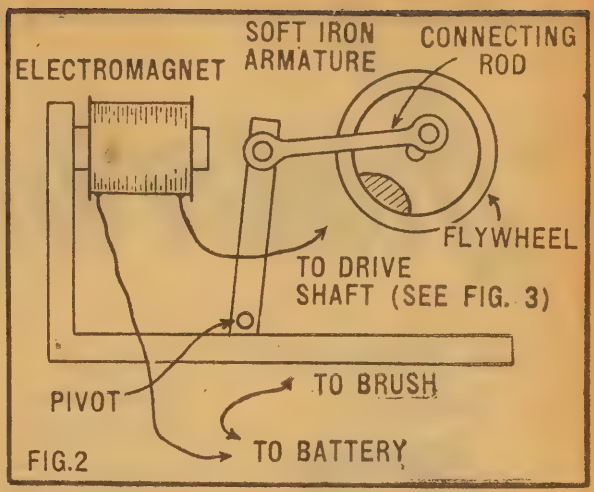


One of the first electric motors ever made was something like this. You could easily make a similar model with a toothed wheel from an old clock.



Another elementary form of electric motor. Its action is very similar to that of a steam engine. A heavy flywheel is necessary to make it run smoothly.

the wheel to a more robust shaft. You may be able to enlist the co-operation of a watchmaker. Most of them have dozens of old clocks which have served their useful life.

If you can't find a wheel of the correct shape, an ordinary gear could be filed to suit. Use a small triangular file such as a saw file and file each tooth diagonally in half. Of course if you like to be very patient you can draw out the shape of the wheel on a piece of metal and cut it to shape with the aid of a hacksaw and file.

You may also like to try your skill and ingenuity in making an electric engine. The general layout is shown in Fig. 2. While the first motor has a whole series of impulses for each turn of the wheel the second relies on one pull from the magnet for each turn of the driving shaft so that a solid magnet and armature are required and in addition, a heavy flywheel must be fitted to the shaft if the motion is to be reasonably smooth.

As you will note from the drawing the electric engine is very similar to a steam engine. The electromagnet replaces the pressure of the steam on the piston and the contact points are the equivalent of the valve mechanism. Maximum power is developed when the contact points are closed for the half-cycle when the armature is moving toward the magnet. About the easiest way to arrange for this condition is to file the drive shaft to a small diameter on one side. Then a piece of springy metal can be mounted on the baseboard to form a brush which makes contact with the shaft for half the complete revolution.

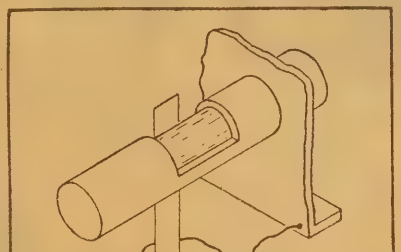
THE ELECTRIC ENGINE

Relate the shaft and the crank so that current is flowing through the coil of the magnet at the same time as the armature is moving toward the magnet. If the circuit is complete while the armature is moving away from the magnet the engine will in effect be working against itself so that power will be lost.

We have made no attempt to give detailed constructional data on either of the motors just mentiond. You will not be able to go into a shop and buy the materials to make them, but will have to depend rather on scrap parts. Perhaps you can think of some other ways in which electromagnets can be employed to make electric motors or engines.

A much more efficient electric, motor can be made if the property on an electromagnet to reverse its polarity when the current is reversed is employed to advantage. Instead of having one impulse for every revolution a very simple arrangement makes it possible to give the armature four distinct impulses for each revolution resulting in more power and smoother operation.

Figure 4 shows the essentials of such a motor. Note the diagram (a) of Figure 4. The two outside magnets are fixed, but the centre magnet is



Detail of the contact for the electric engine shown in Fig. 2.

mounted on a shaft and able to revolve freely. The two outside magnets may be either electromagnets or permanent magnets as is convenient, but the centre one must be an electromagnet.

With the current flowing through the coil of the centre magnet in one particular direction, the left-hand end is the south pole and the right-hand end the north pole. Since unlike poles attract the centre magnet or armature is turned around in an anti-clockwise direction.

However, at the exact instant that the armature draws level with the field magnets, the current is reversed and the polarity on the armature changes so that instead of the poles of the armature being attracted to the field magnets they are repelled with equal force. Thus, the armature continues to rotate in the same direction.

The same thing happens when the armature goes through half a turn and opposite ends of the armature present themselves to the field coil. At the instant of drawing level with the field magnets, the current in the armature reverses so that shaft always turns in the same direction.

The mechanism which accomplishes this periodical reversal of current is shown in Fig. 5. It is mounted on the same shaft as the armature so that it operates quite automatically as the armature turns.

CONSTRUCTIONAL PROBLEMS

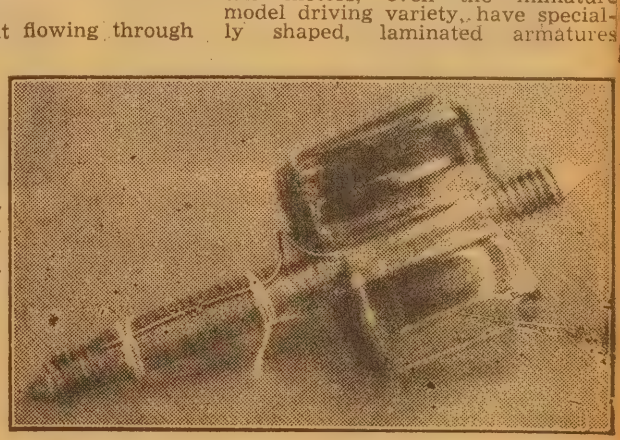
It is all very well to understand a written description of the working of a mechanism, but it is far better to see the mechanism working for yourself and, better still, to make it yourself.

In the ordinary way, electric motors present a major problem to home constructors. Commercial electric motors, even the miniature model driving variety, have specially shaped, laminated armatures

☆

Detail of the armature showing how the simple commutator is made. The picture is larger than twice full size.

☆



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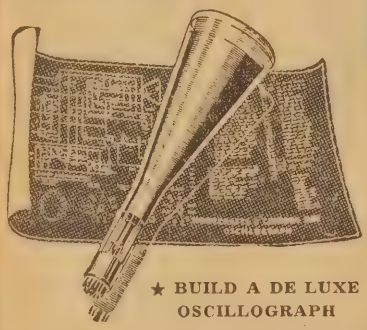

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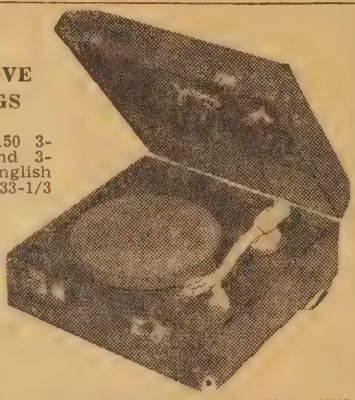

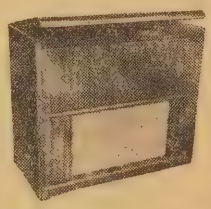

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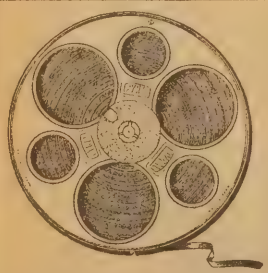

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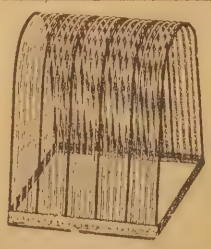

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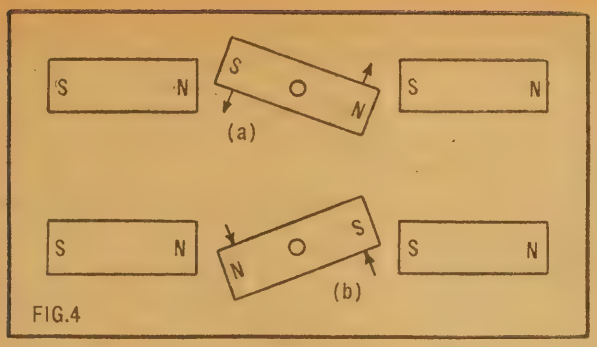


FIG.4

This is how a simple electric motor works. The electromagnet at the centre reverses its polarity each half revolution.

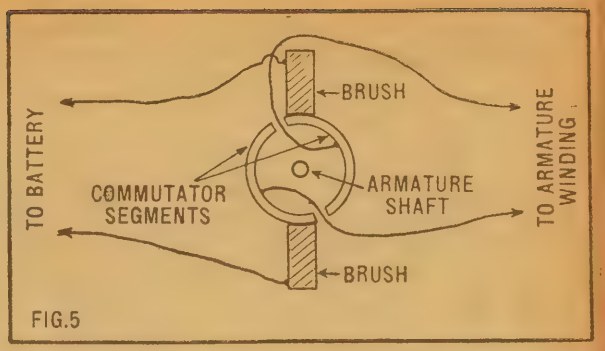


FIG.5

The current flowing through the armature coil is reversed automatically as the motor turns by the commutator.

which are stamped from thin sheets of soft iron. The commutator is made with the aid of a lathe so that it is perfectly true, and the brushes make perfect contact throughout the complete rotation.

The amount of ingenuity can compensate for precision engineering, but the little model we are about to describe gives an excellent performance despite the fact that its main parts were cut from an old tobacco tin with a pair of scissors. (Tinplate isn't very kind to freshly sharpened scissors, so we would suggest that you follow the advice of the workshop handbooks and use tinsnips instead.)

To make the motor you will need a small scrap of tinplate, 8 1-8in bolts, 10 nuts and 4 washers. Also, in addition to a length of 35-gauge enamelled wire you will need a scrap of three-ply for the baseboard and a length of 1-8in rod for the shaft which supports the armature and commutator.

In this motor the field is created by an electromagnet rather than a permanent magnet since not many constructors are likely to have a suitable permanent magnet available.

MAKING THE PARTS

The first job is to make the field. The frame is bent up from a piece of tinplate ½in wide to the shape shown in Fig 6. Start with a piece of tinplate about 4½in long. You can cut the excess off later. It is very hard to bend the tinplate to the required shape without some sort of a form. Probably, the best way is to cut out the shape of the field from a piece of wood and then bend the tinplate around the wood. With the aid of the form you could almost do the job with fingers alone. Alternatively, you could make all the angle bends with the aid of a pair of pliers and shape the rounded portions on a piece of round material, such as a broom handle.

The armature core is made up of two identical pieces of tinplate, bent up from 3-8in wide stock. You should be able to manage the job of bending them to shape quite easily with the aid of a pair of pliers.

The small bend in the centre of each section of the armature is most easily made by bending the strip over the armature shaft and then bending it back to the required extent.

The armature shaft is a piece of 1-8in rod 1½in long the ends of which are filed to a sharp point so that they will fit into dimples in the two upright brackets to form freely running bearings. The dimples can be made with a nail, taking care not to hit it so hard as to puncture the metal, otherwise the bearings will not run as freely as possible. Incidentally the brackets are cut from 3-8in wide material 1 1-8in long, the last 3-8in being bent at right angles to form the foot leaving the upright section ¾in long. The dimple in the metal is made ¼in from the top so that when the motor is assembled the armature shaft is ½in above the baseboard.

THE BASEBOARD

The baseboard is a piece of three-ply 3in by 1¾in. Eight 1-8in holes are required, but we suggest that you drill these after completing all the other parts for the motor, as you will then be in a position to make allowances for any small inaccuracies.

It will only take you about two hours to make the motor if you have all the materials on hand and a goodly portion of that time will be taken in winding the field and armature coils. Start with the field coil as this is the easier of the two and will give you practice which will assist you in winding the armature.

INSULATION ESSENTIAL

It is important to make sure that the wire does not touch the tinplate parts of the motor, otherwise there is likely to be a short-circuit, which would result in either the motor not working at all or a substantial loss of power. Although the wire has a coating of insulating enamel this is not strong enough to withstand rubbing against the sharp edges of the tinplate. A good way to prevent this is to paste a layer of brown paper around the section of the field frame over which the coil is to be wound. Alternatively, if you have some cellulose tape, a good insulator

(Continued on Page 83)

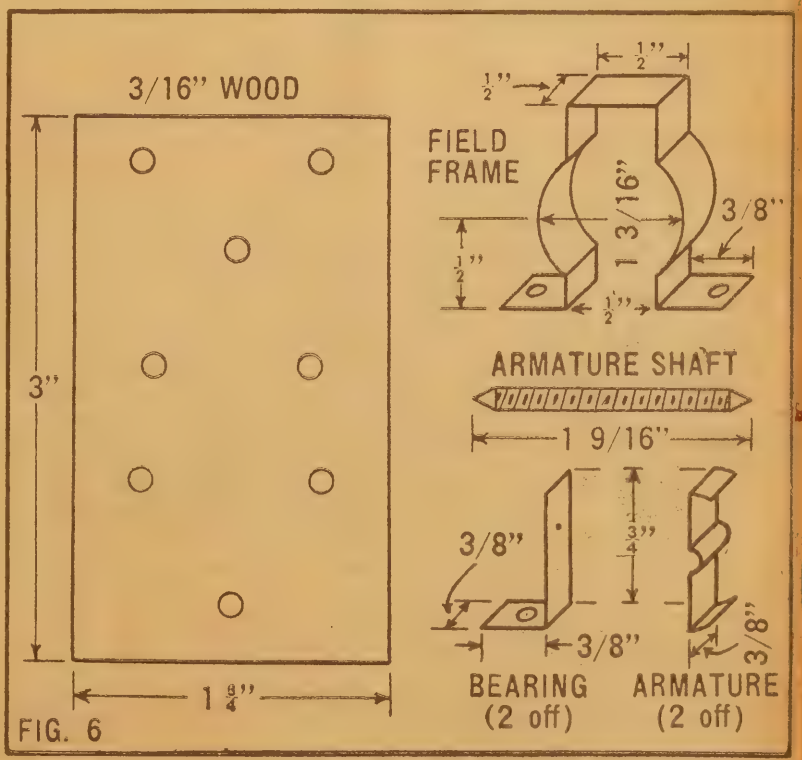


FIG. 6

The parts for the miniature electric motor are shown full size. Be careful to make a good job of the field frame.

Let's Buy An Argument

It's a sad commentary when a supposedly progressive journal like Radio and Hobbies continues to ignore reflexing—an idea which returns so much for so little. But does it? I'm going to answer the question in the negative and suggest that reflexing is a rather woeful system that pays its way on only rare occasions.

by W. N. Williams

JUST to get our ideas in line, I use the word "reflex" to describe the practice of making one valve amplify the incoming signal twice over, at two separate and distinct frequencies. As a rule, it amplifies first at the radio or intermediate frequency, then again after detection at audio frequency.

I haven't tried to establish how old the idea is, but it certainly dates back to the days when most listeners built their own sets.

I can remember one little set using an ubiquitous "general-purpose triode" and a crystal. The triode amplified the signal from the aerial, then passed it on to the crystal. It was duly rectified and the audio component passed back into the triode for further amplification before being fed into the phones. It worked very well, according to our ideas in those days.

In actual fact, there was a good deal in favor, then, of employing the reflex idea wherever possible. Valves were relatively much more expensive and scarce than they are now and the cost of running them from batteries was often a problem. We weren't very choosey about the finer points of reproduction, the criterion of a set's performance being (1) whether you could get the station, and (2) whether you could understand what the man was saying.

This statement is literally true. I well remember one popular line of commercial receivers—bakelite panel jobs—which could produce louder signals than any other set at the time. The trouble was that the speech could be followed only with the greatest difficulty.

Don't believe me? Then get yourself a simple detector, audio transformer and a battery triode, put 90 volts on the plate, apply no bias, feed the output into a horn speaker with fixed diaphragm and tell me how you like the result. To do the job properly, of course, your signal should have come from a Reiss microphone, and through a transmitter of doubtful distortion content.

Yes, in those days, when we were just finding out about grid bias, "power" valves and such like, the limitations of the reflex circuit weren't very important.

NOT ATTRACTIVE

But, thank goodness, we've come a long away since then, and our sense of technical values has altered somewhat. Nowadays, the proposition of reflexing doesn't look at all attractive to my way of thinking.

What prompted these particular remarks was a letter received recently from a country reader who had spent a lot of time designing an elaborate battery dual-wave set. The main feature, on which he was apparently "sold," was the use of a reflexed IF amplifier.

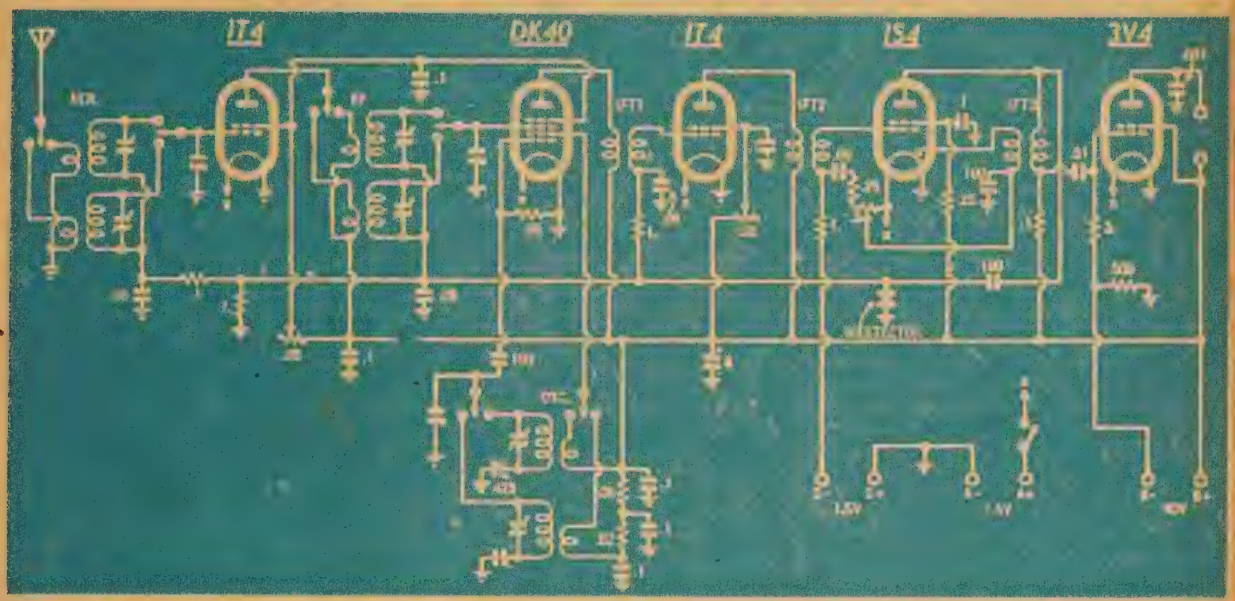
Let's look at the circuit objectively and see just where it all gets him. We needn't worry about the merits or the demerits of the design in other respects. The point of note is that he has arranged the 1S5 as a reflexed amplifiifier. The signal is fed to the grid first at 455kc, duly amplified, and passed on to the diode. After rectification, it is fed back into the grid for amplification at audio frequency, after which it passes to the grid of the output valve.

In the first place, if the 1S5 can be made to give useful gain at 455 kc, it will almost certainly render the whole IF channel unstable with normal high-gain transformers. The first essential, therefore, would be to obtain transformers designed for two-stage operation, and these may or may not be available.

Having duly obtained the special transformers and got everything working, to best advantage, the ultimate gain and selectivity might be a little better than with the conventional channel, but, then again, it mightn't because the 1S5 isn't designed for RF service.

The next point is that the 1S5 would normally have to handle the full signal handed on to it by the three earlier stages and it might well be quite a signal! Even allow-

IS REFLEXING WORTH WHILE WITH THIS RECEIVER?



A reflexed battery superhet circuit suggested by a country reader. It would probably exhibit all the worst features of the principle without gaining any advantage.

ing for the application of some kind of bias to the grid, it's pretty certain that the distortion level at the plate would be extremely high, even if the valve had everything its own way. But it hasn't—not by a long shot.

This valve has a 0.1 meg. audio load in the plate circuit, which would sadly reduce still further its ability to handle heavy signals. The result—colossal distortion!

In other words, the 1S5 would function very effectively as a detector and generate considerable audio signals across the plate load for direct application to the grid of the 3V4. The diode, the audio circuits and the volume control, incidentally, stand helplessly by while this goes on.

Of course, some of the signal will get through to the diode and pass, via the volume control, back to the reflexed grid. It may duly be amplified and appear in the plate circuit, most likely out of phase with the component already present from the earlier detection. The result is a familiar one.

CONTROL TROUBLES

With the volume control turned right off, a fairly substantial signal can be heard. As the control is gradually advanced, the signal gets weaker and more distorted as one component tries to cancel the other. Advancing the control still further increases the volume again and gives cleaner reproduction.

Unfortunately, in this set, the reproduction might never attain any degree of clarity for the very obvious reason that the audio plate load of 0.1 meg is far too low a value for the 1S5 as an audio amplifier. At the best it might just manage to drive the 3V4, but the poor "bottle" is already overloaded with an 1F component. I shudder to think of the result.

Now our correspondent was alive to some of the difficulties—at least the ones to do with the minimum volume effect. He reasoned that the trouble would largely disappear if means were incorporated to reduce the RF gain when receiving strong signals. In line with this, potentiometers were included in the screen circuits of the RF and IF amplifiers

EXTRA KNOB

The idea of providing this extra manual gain control was not original to the reader in question, but was borrowed, so he said, from a reputable published circuit. Maybe it was—but that does not necessarily make it worthwhile. The extra controls would certainly complicate the tuning of the set by non-technical members of a household.

In fact, when you add it up, the proposed set has all the parts which would be involved in a 6-valve job except one valve and a socket. The saving would be a very small percentage of the gross cost of parts, but at what a sacrifice in performance?

And I'm afraid that's very often the case with a reflex set. All kinds of clever things are done to lead the signal hither and thither, but, by the time you're finished, just as many parts are involved as if the extra valve had been added, anyway. And you've introduced, meantime, likely problems with "minimum volume" distortion and instability.

It would be silly to infer, of course, that all reflex sets can be criticised to the same degree as the battery set to which I have referred. By careful design, it is possible to minimise distortion and minimum volume effects so that they are not too objectionable, particularly in remote areas or where the set always operates at reasonably high volume

But there is invariably a compromise involved: The reflexing always involves extra parts, and the performance is never as good as if a separate and additional high-performance valve were added. Furthermore, under large input-signal conditions, the reflex set can always be relied upon to produce more distortion than a good straight set.

I have yet to discover any reflex set or circuit which rates as an exception to these observations.

It is, therefore, incorrect, as I see it, to claim that the reflex circuit offers the advantages of an additional stage "for nothing." The best one can say is that it gives the opportunity of boosting the gain of a set without using an extra valve, but at the price of additional components and a compromise performance in other directions.

SMALL SETS

Assessed on this basis, we have generally concluded that reflexing isn't worth the candle in a medium to large set, because the disadvantages of the circuit outweigh any possible saving. In a small, low-priced receiver a better case can be made, but the issue remains very much in the balance.

Our most recent experience with reflexing was associated with the "Reflex Four" receiver, featured in the October 1950 issue. This employs what is probbaly the neatest and cleanest system of reflexing yet devised.

The incoming IF signal is fed to the grid of the 6AR7-GT and amplified in the usual way, to appear in the plate circuit. They are then transferred to the detector diode for rectification, after which they

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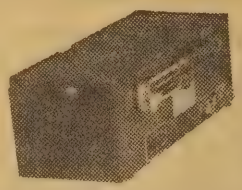

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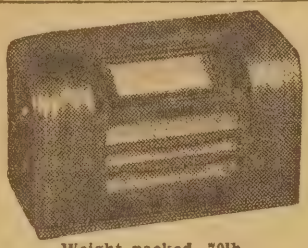

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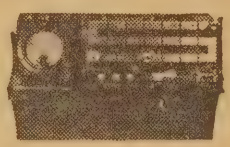

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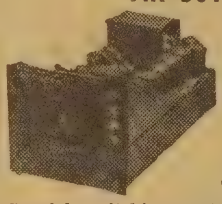

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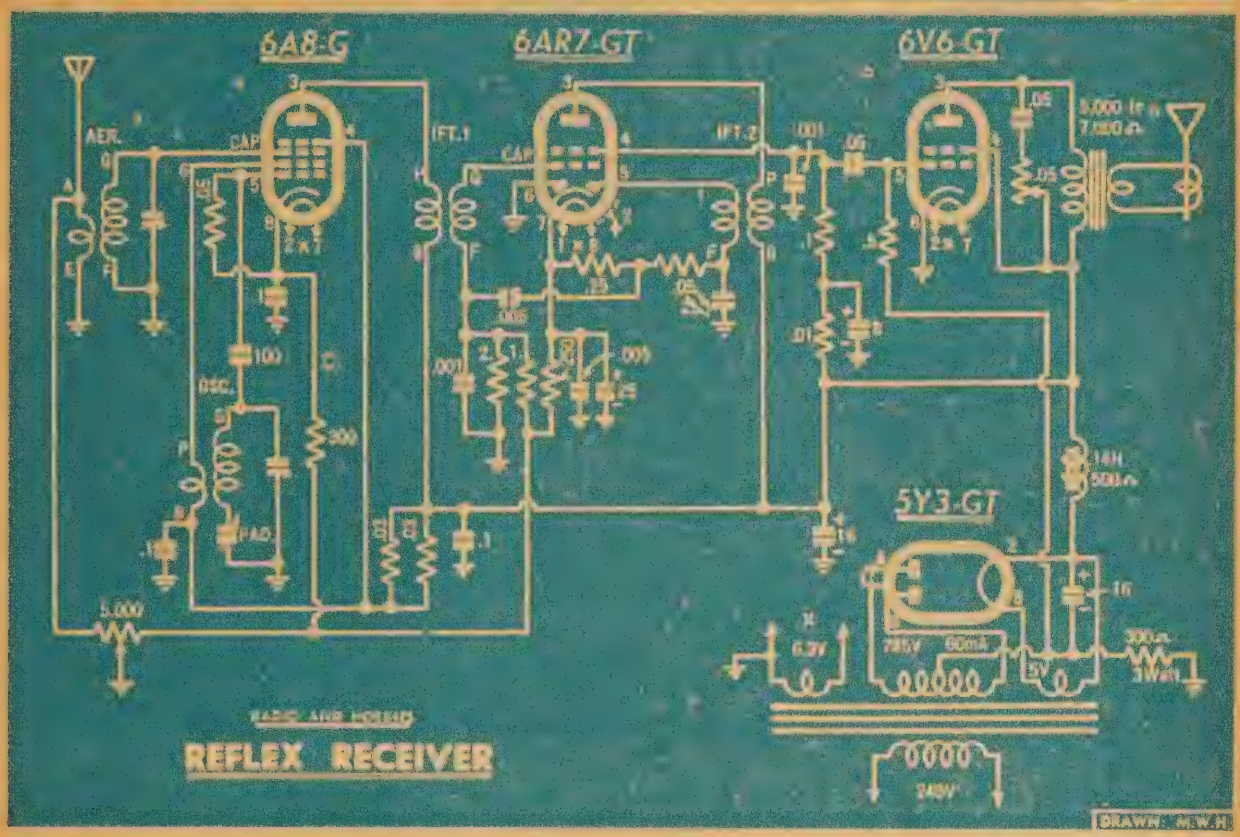
CIRCUIT DIAGRAM FOR THE REFLEX RECEIVER



The reflexing around the 6AR7-GT is just about as neat and straightforward as it could possibly be yet we had to sacrifice AVC to use it.

are fed back to the 6AR7-GT grid in the form of pure audio.

As such, they vary the plate and screen current, but no audio voltage can appear in the plate circuit because there is no audio load present—only the winding of an IF transformer.

The screen, however, is fed through a 0.1 meg. resistor, and by reducing the value of the screen bypass so that it operates for RF only amplified audio voltages appear at the screen. From here, they are coupled to the grid of the output tube.

RF AND AUDIO

Thus, the valve operates as a pentode amplifier for IF signals and as a triode amplifier for audio signals the gain in the latter case being quite useful.

The beauty of the scheme is that the valve operates under normal conditions, because the full HT voltage is available at the plate, and the audio load in the screen circuit is nothing more nor less than the dropping resistor which would be incorporated in any case.

Contrary to the instance of the poor little IS5, referred to earlier, the 6AR7 has everything its own way. If any reflex set should work without complication it would be this one.

We duly built it up, with AVC incorporated, and with the general idea that the set would handle and sound just like an ordinary 5-valve job for it did, indeed, have an audio stage between the diode and the output valve.

It certainly had plenty of gain, but the minimum volume effect was present in no uncertain manner when the set was tuned to a strong local station. By fiddling with the AVC circuit and applying feedback, it could be cut down quite a lot, but the set just couldn't be played comfortably at very low volume, because of the high distortion.

By using a different form of feedback and a much higher feedback factor, we may have reached the "just about right" stage, but then the overall gain wouldn't be very much higher than with no reflexing at all.

Of course, the feedback might have improved the "high volume" performance of the audio system itself, but efforts in this regard would be offset to a large extent, by the limitations of the small speaker and cabinet, and by the tendency to increased distortion in the "IF amplifier" function of the 6AR7-GT.

We dodged these problems by cutting the AVC out altogether and using manual gain control. This left us with a 4-valve set having very high overall gain, no minimum volume effect, no serious distortion problems—but no AVC either!

By using higher gain tubes than we specified, some real sensitivity figures could be achieved, but is it worth the price of an AVC system? Or, if you must have AVC, is it worth the low volume distortion that will inevitably occur on strong signals? Think it over!

HERE'S YOUR ANSWER TOM!

(Continued from Page 35)

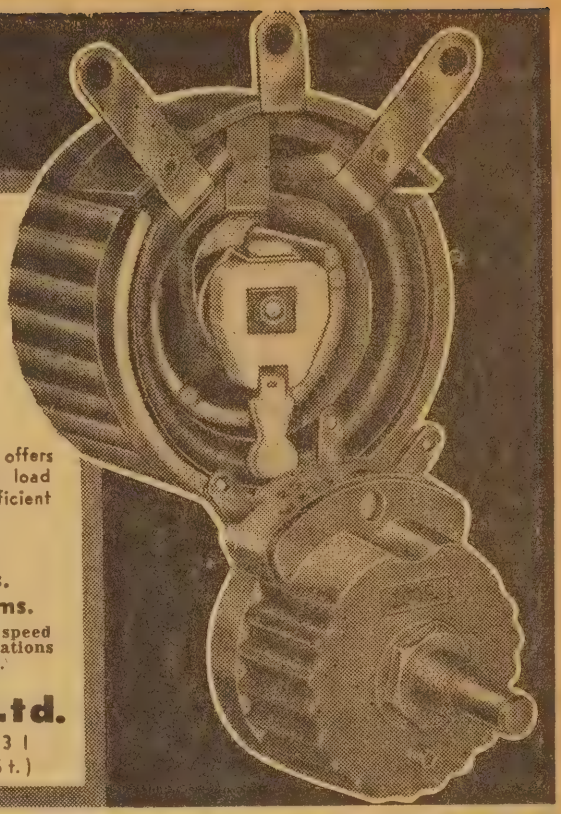
of low resistance phones from a crystal set there would be no sense in adding a series resistance. As a matter of fact, the sound would be louder without the resistance, despite the big mis-match.

In the latter case, the best way out of the problem is to use a matching transformer, designed to reflect a high resistance from the low resistance of the phones. Because of the large number of low resistance phones which have been made available from military disposals such transformers have been quite easy to obtain.

By the way, if you wish to operate a pair of phones from a power valve, some form of coupling device is absolutely essential because the plate current of valve would damage the windings of the headphones. It could be either a transformer or a resistor capacitor combination, whichever is the cheaper and more convenient.

IRC

Power RHEOSTATS



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A COURSE IN TELEVISION

PART 33—TELEVISION AERIAL SYSTEMS

The provision of a suitable system is vital to the reception of a good television image. The present series would not be complete, therefore, without a study of VHF aerial systems, covering both the basic principles and the types of array typically employed.

BEFORE becoming involved with the actual design of aerials it may be as well to say something about the propagation characteristics of VHF signals as distinct from signals radiated at lower carrier frequencies.

On the familiar broadcast band, for example, the signals may travel from transmitter to receiver by a direct path along the earth's surface or they may be refracted (or reflected) by the ionosphere, as shown in figure 1.

The ultimate coverage of a broadcast station depends a good deal on radiated power, on terrain, weather conditions, time of day, and so on, but useful signals may often be received over a distance of several hundred miles.

IN HF REGION

The bending effect of the ionosphere is vital also to long-distance short-wave communication, but it ceases to operate effectively in the region of 30-50 Mc. Beyond this limit the only useful signals are those which travel direct from transmitter to receiver along the surface of the earth. Energy radiated upward from the aerial is therefore wasted. (Figure 2.)

A further point is that these higher frequency signals tend to behave more and more like light beams, travelling most easily in a straight line. Hills and buildings can produce shadow and reflection effects and optimum conditions exist for reception where there is a clear line of sight between the transmitting and the receiving aerial.

Actually, the coverage of a VHF transmitter does exceed the strict line-of-sight definition because local reflections and the refractive effect of the atmosphere do tend to fill in local hollows and to extend the overall coverage by some 25 to 35 pc.

It follows that, for best coverage, a VHF transmitter should be located in the highest possible position and favored sites are atop mountains or tall buildings overlooking the area to be served.

While it is usually reckoned that the range of a television transmitter is limited to about 30-40 miles a great deal depends on the choice of site, as will be evident from the curves of figure 3.

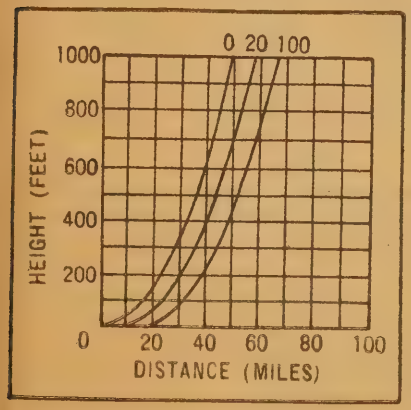


Figure 3. This graph shows the anticipated range of a VHF transmitter for varying heights of aerial at both transmitter and receiver.

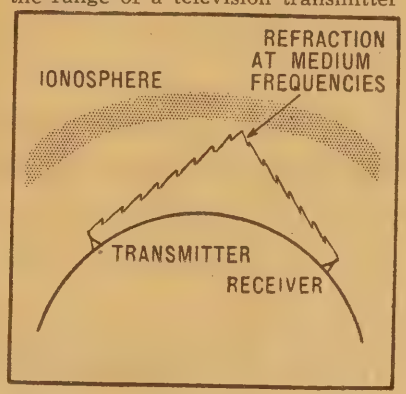


Figure 1. Illustrating the bending effect of the ionosphere on radio waves up to a frequency of about 30 Mc.

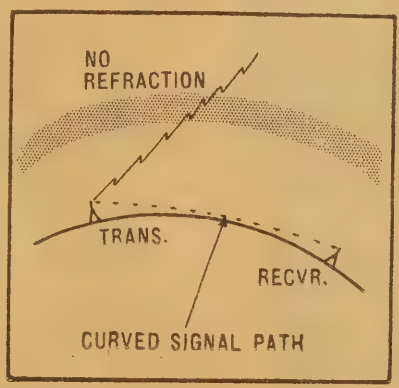


Figure 2. VHF waves are not refracted reliably by the ionosphere. They are bent, however, by the atmosphere and follow the path illustrated.

It is also evident that a high position for the receiving aerial is desirable, both to approach the "line-of-sight" condition and to get the aerial clear of surrounding objects. (Figure 4.)

Another important matter which must be considered is that of signal polarisation.

A radio wave consists of electromagnetic and electrostatic fields at right angles to each other and the polarisation of the wave refers to the relationship of the electrostatic field to the earth's surface.

If the electrostatic field is vertical with respect to the surface of the earth the wave is said to be vertically polarised. Conversely, if the electrostatic field is parallel to the earth's surface the wave is said to be horizontally polarised.

The polarisation of the wave is determined initially by the transmitting aerial. While there are special exceptions it generally works out that a horizontally polarised wave is radiated by an aerial whose active elements are parallel to the earth's surface. Vertical elements give vertical polarisation—again with special exceptions.

POLARISATION

For best results, the receiving aerial should have the same polarisation as the transmitting aerial and the would-be constructor must first determine the standard adopted by the desired station (or stations) before proceeding with his own design.

Horizontal polarisation has been adopted as the tentative standard for Australian television stations and we can proceed later to the discussion of aerial arrays on this basis.

Use of the word "array" suggests that there is something special about an aerial designed for the reception of VHF signals and such, indeed is the case.

For normal broadcast listening, and

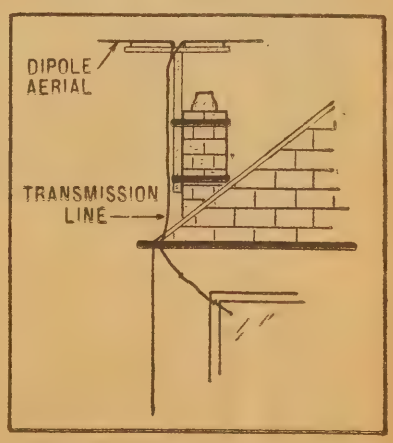
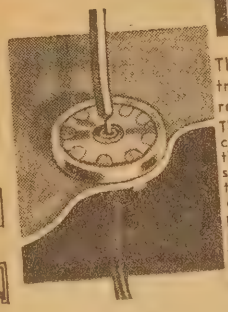


Figure 4. A television aerial should preferably be mounted in an elevated position and connected to the receiver by a suitable transmission line.

UCC INFORMATION BULLETIN

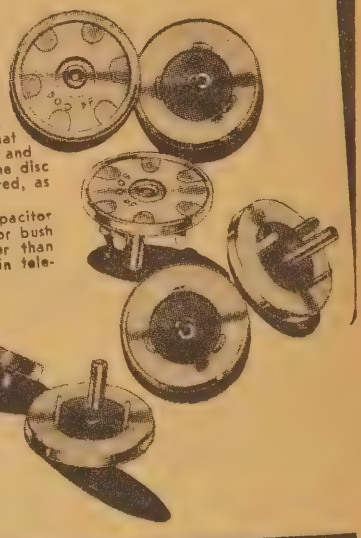
MICADISCS



This type of "Micadisc," a smaller version of the larger transmitting types, is designed especially for radio receiver application.

They are of stacked foil construction, contained in a circular-plated brass case, which forms one terminal. The case is provided with three lugs so that the capacitor may be mounted directly on the chassis, the lugs bent over and soldered. The other terminal is formed by a tag-eyelet at the centre of the disc through which a lead may be passed, soldered and continued on it desired, as depicted in the illustration at left.

Due to the peculiar construction, the current enters and leaves the capacitor radially. With the method of mounting, this achieves in effect a capacitor bush with extremely low inductance and operational characteristics to better than 200 M/cs, which is ideally suited for bypass and decoupling functions in television and other U.H.F. applications.



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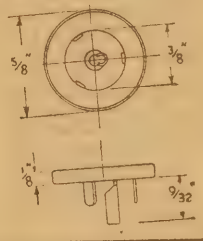

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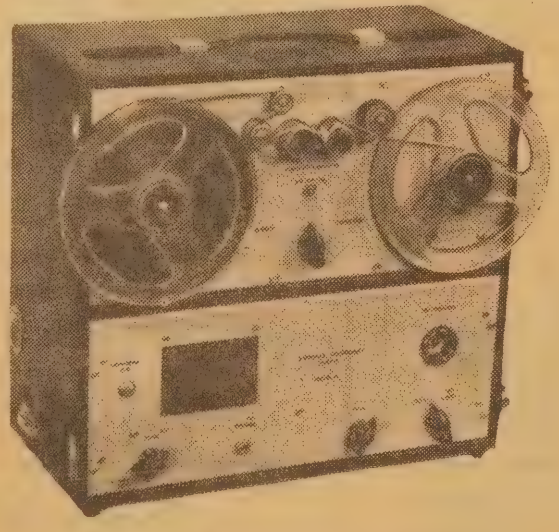

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even a good deal of short-wave reception, our ideas of a receiving aerial have largely been restricted to a length of wire tacked around the picture rail or strung to a nearby tree. No special attention is paid to aerial height and length, apart from the general idea that increasing the length and height of an aerial increases the signal pickup and vice-versa.

In general, this simple approach is quite permissible because an unpretentious aerial can usually pick up sufficient signal on the broadcast band for an ordinary set to amplify to the required degree.

With higher signal frequencies, however, the position alters and the following factors emerge: (1) It becomes progressively more difficult to achieve high gain in the receiver and (2) It becomes possible, because of the shorter wavelengths, to use aerials which are naturally resonant at the signal frequency. Such aerials supply the receiver with an input signal much larger than would otherwise be the case.

BEAM AERIALS

By the addition of simple reflecting or directing elements, it is possible also to concentrate the pick-up area of an aerial in a specific direction, reinforcing the desired signal and discriminating against interference.

Without laboring the point further, it is sufficient to say that all television receivers overseas are designed for use with resonant aerial systems and TV-equipped homes are invariably distinguished by attic or roof-top aerials.

The simplest resonant aerial is known as a half wave "dipole." This consists of two wires or rods each approximately ¼ wave length long, mounted end to end, but with a gap of approximately one inch between ends (see figure 5).

Although referred to as a half-wave dipole, the length of each component arm is normally about 5 pc less than the calculated length of a quarter wave corresponding to the frequency for which the aerial is cut.

Thus, the procedure in designing a half-wave receiving dipole is first of all to decide on the frequency for which it is to be cut and then, by dividing megacycles into a figure of 300, to determine in metres a figure for one wavelength. Dividing this figure by four will give you the length of an electrical ¼ wave.

The correction factor of 5 pc mentioned above makes it necessary to multiply the electrical ¼ wave length by a factor of .95 to give the length of each component section of the dipole.

CONVERTING TO INCHES

When converting to inches it is necessary to remember that there are 2.54 centimetres to the inch and 30.48 centimetres to the foot. One metre is equal to 39.37 inches.

Actually the conversion into feet can be accomplished automatically by dividing the frequency in megacycles into 246. Taking into consideration the 5 pc correction factor, the length of each half of the dipole can be calculated directly in feet by dividing 234 by the frequency in megacycles.

By way of example we may desire to erect a dipole aerial which is

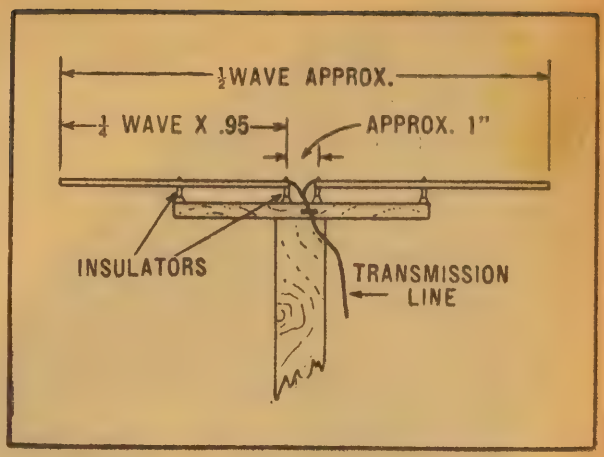

Figure 5. The essential dimensions of a simple half-wave dipole aerial. It receives the strongest signal when broadside on to the desired station.

resonant at 200 mcs. This corresponds to a wavelength of 1.5 metres, so that an electrical ¼ wave corresponds to 0.375 metres. The 5 pc correction then gives a figure of approximately 0.356 metres. Converting to inches, the answer is very close to 14.

Using the simplified formula, the same answer is obtained by dividing 234 by 200. to give 1.17 feet or 14 inches.

Thus a half-wave dipole for 200 mcs. would consist of two 14-inch thin rods or wires mounted end to end, with a gap of about one inch at the centre. Actually the gap could be smaller than this, being determined largely by the nature of the insulators used at the centre.

CORRECTION FACTORS FOR ROD HALF-WAVE AERIALS

Mc.	Diameter	Factor
166	¼ inch	.995
	½ inch	.985
	½ inch	.975
	1 inch	.965

A typical group of correction factors extracted from an amateur publication and based on length/diameter ratio.

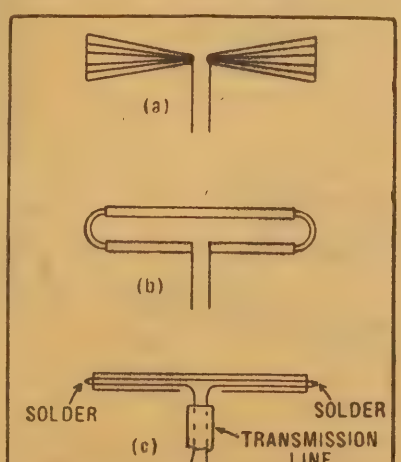

Figure 6. A twin conical dipole (a) gives a wider response band than a simple dipole. (b) shows a folded dipole with adjustable metal ends and (c) a folded dipole cut for a specific frequency from a length of twin lead.

For most practical purposes, the results yielded by this calculation will be adequate but, where greater accuracy is required, further allowance can be made for the diameter of the aerial rods, based on their length-to-diameter ratio. This compensation becomes quite significant in arrays where, for reasons yet to be explained, the aerial elements are made quite bulky.

While all this is simple enough where only a single television station is concerned, difficulty arises when the listener wants to receive two or more stations operating on different frequencies. A simple dipole, cut for one frequency, may be very inefficient on the other signals.

In special cases, it may be satisfactory to adjust the aerial for a weak station and put up with losses on the others. Alternatively, some intermediate setting between the required limits may produce a workable compromise and, in line with this approach, some commercial aerials have sliding end extensions to facilitate adjustments by trial-and-error.

BROADER RESPONSE

Fortunately, there are ways by which the response of a dipole can be made less sharp in terms of frequency. Effectively, its "Q" factor is reduced or its selectivity is reduced—to use terms commonly applied to ordinary tuned circuits.

One simple method is to construct the arms of the dipole from large-diameter tubing, applying a suitable correction factor as already mentioned.

Still another method, as shown in figure 6a is to construct the dipole from a series of rods or from sheet metal to produce a conical form.

Figure 6b and 6c suggest yet another type of broad-band aerial, namely the folded dipole. In this type two or more rods are used and bridged across at the ends. One rod is broken at the centre, as in the simple dipole, for the insertion of the feed line.

Length of the individual rods is measured from the mid point of the bridge each end and is a half wave-length less the correction factors already mentioned for end-effect and length-diameter ratio.

Folding a dipole in this way influences its connection to the receiver feed line but we shall consider this separately in a later issue.

The spacing between the constituent elements in a folded dipole is not specially critical, although it

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DISTORTION IN MAGNETIC TAPE

ONE of the attractive features of magnetic recording is that the media are inherently free of even harmonic distortion; the magnetisation characteristic is not necessarily linear, but is symmetric for opposite directions of magnetisation. However, in practice, playback wave analysis of a sine wave recorded from a distortion free source will frequently show appreciable second and higher even order distortion.

When this is found, it is indicative of some defect in the recording equipment, and the purpose here is to point out what these flaws may be and how to determine and correct them.

A possible source of trouble is in the audio amplifiers, both record and playback. Distortion from this cause may be determined by conventional amplifier testing and eliminated by known techniques not peculiar to magnetic recording.

The causes of even harmonic distortion, which are in the recording process itself, all have one thing in common. This is a direct current component or magnetisation which prevents the heads from modulating the tape about the point of symmetry, which is the state of demagnetisation.

The asymmetric influences may be most clearly visualised in their action at the record head, but if the erase head leaves the tape magnetised, the same results may occur. The troubles which lead to asymmetric recording are as follows:

MAGNETISED HEADS

Heads may become magnetised by accidental contact with magnets, by mechanical strains in a magnetic field, or, very commonly, by excessive transient currents occurring in the switching of recording, erasing, or biasing currents.

DC COMPONENT IN ERASE OR BIAS

This is an obvious difficulty; some dubious circuit designs have allowed the DC of a tube's plate current to flow through the head, but if such undesirable design is avoided, DC can only result from a leaky capacitor or other faulty component.

ASYMMETRIC BIAS AND/OR ERASE WAVEFORM

Even if no DC component is present, a waveform with different positive and negative peak values will cause the same effect. This is caused by overload or inadequate design in the high frequency supply.

STRAY DC FIELDS

These will produce the same effect as any of the sources of DC fields located in the head. Ordinarily the earth's magnetic field is negligible, but serious fields can be caused by magnetised steel parts or especially by nearby meters.

In testing for the existence of asymmetric fields, a small permanent magnet which may be held near the heads is a help. If some position of this magnet reduces even harmonic distortion, the polarity of the magnet should be noted and conditions changed. The heads may be demagnetised by gradual removal from a 60-cycle field of about 1000 coersteds.

Bad waveform may be tested by reversing the leads to the heads; if such reconnection changes the amount of distortion or the polarity of the magnet held nearby to improve it, then the waveform is not good

Any steel parts should be demagnetised and any nearby meters temporarily moved to see whether there is an effect. Generally more than one influence is at work with their effects sometimes additive and sometimes subtractive, so it is important to separate the various causes; otherwise very wrong conclusions may be drawn.

It is also worth noting that these same factors which cause even harmonic distortion work to increase noise, and their removal will lower the noise as well as lessen the distortion.

A COURSE IN TELEVISION

(Continued from Page 67)

should always be less than one-tenth wave-length.

It is usual, however, for the tubing to be mounted close together at a distance determined by the mounting arrangements employed. It is permissible, by the way, for the centre of the unbroken element to be clamped directly to a metal mast which is often a distinct constructional aid.

Much attention has been paid, in the US, to the design of broad-band aerial systems because their current or proposed stations are spread throughout the spectrum from 50 to 200-odd mc. The difficulty of providing an aerial to give any sort of response over this large range is manifest.

One scheme, which is frequently adopted, involves the connection of two separate folded dipoles—or other broad-band aerials—to the one transmission line, the dimensions being chosen so that each dipole gives a broad response over one sector of the spectrum.

Sometimes aerial tuning boxes are used as an auxiliary and a switch provided so that physical discrepancies in the aerial and feeder length can be corrected electrically at the receiver end.

It seems unlikely that more than one or two stations will be available to Australian viewers for many years to come in any one centre, so that the same extensive problems are not likely to arise. If two stations are available and their operating frequencies are kept reasonably close in the spectrum, a simple type of broad-band aerial is likely to be sufficient.

Before pursuing this subject further, however, it will be necessary to diverge and to examine the characteristic impedance of resonant aerial systems and the methods of connection to the receiver.

This we plan to do in the next issue.

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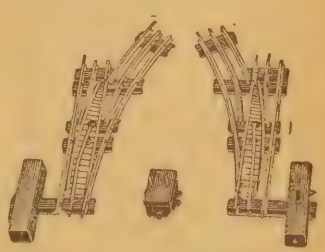

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

SIMPLE TELEPHONE SYSTEM FROM DISPOSAL PARTS

With a few items from Disposals sources, you can make this simple line telephone system having a 101 uses. Submitted by a Victorian reader, this unit can take up routine duty on the farm, workshop or home or form the backbone of a lot of fun for the youngsters.

OUR contributor, Mr. R. N. Jackson, Box 83, Frankston, Victoria, built this unit entirely from items, which were, and, in many cases, still are, available from Disposals sources.

The physical arrangement of the system can be made to suit individual requirements and so the description will centre solely upon the circuit wiring of the components. The items required are a buzzer unit type T MK1 (the type which has two adjustment knobs on the front and six pressure contacts on the underneath), a carbon microphone insert, a single low resistance headphone, a 3-volt battery and a suitable switch. A conventional telephone handset may be used or the microphone insert and the headphone arranged in a manner similar to a handset.

BUZZER UNIT

The heart of the system is the buzzer unit. It acts as a microphone transformer and, in conjunction with the 3-volt battery, as a call signal generator.

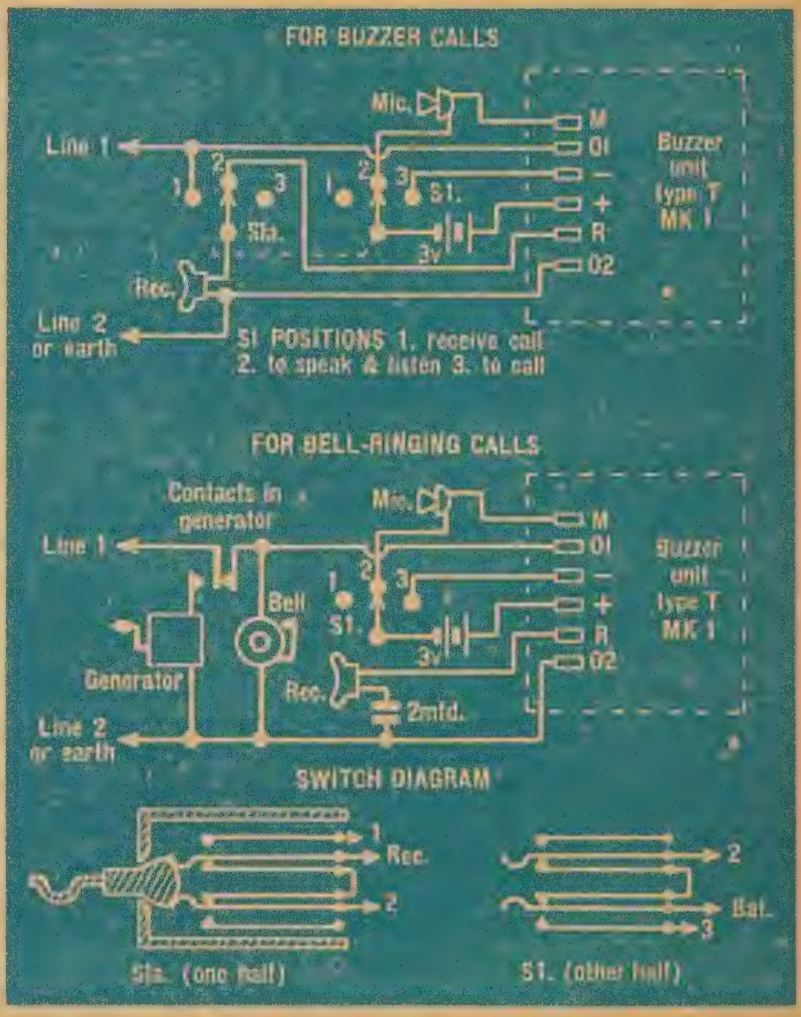
The wiring of the unit as shown in the daigrams is self-explanatory. Either one system or the other may be used, the only difference being, of course, in the type of calling signal. For complte two-way communication, two units will be required, one at each end of the line.

If more than one line is required, the additional lines can be selected at each unit by a rotory switch or jack plugs, or, more simply, all lines can be paralleled and a calling code employed. Some consideration may need to be given to reduced intensity of buzzer note when a number of lines are paralleled.

The switch S1 may be of the wafer type used in radio sets or, preferably, of the standard PMG key type. This latter type can be simply modified to provide the self-switching facility afforded by a standard telephone set, thus avoiding inconvenience of a switch being left in the incorrect position at either end of the line. The drawing indicates the necessary modification of providing a hook for the handset.

The action required in this switch is a double-pole, double-throw, two bank. The type having a spring-return both ways would be ideal. The drawing shows the arrangement of the leaves at rest, or in the "centre" position of the switch. The "down" position would be the "receive call" position and the "up" position would be the "call" position.

Our contributor says that switch bank S1a may be omitted, if desired, and the receiver connected between the "R" and "O2" contacts on the buzzer. While simplifying the switching a little, this results in slightly weaker buzzer signals.



For bell-ringing calls, the switch section S1a is omitted and the receiver is wired from "R" to "O2" on the buzzer unit in series with a 2 mfd capacitor.

The alternative circuit shows the arrangement for bell-ringing calls. You will need a telephone hand generator and bell for each unit. The internal contacts of the generator automatically place it across the line when the handle is turned.

If at first the buzzer does not operate, adjust by loosening off the locking collars and unscrewing both knobs several turns. Slowly advance one knob until a note is heard and lock with the collar. Screw in the other knob until the note is clear and fairly high-pitched and lock with the collar.

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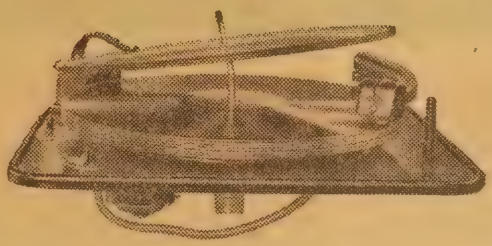

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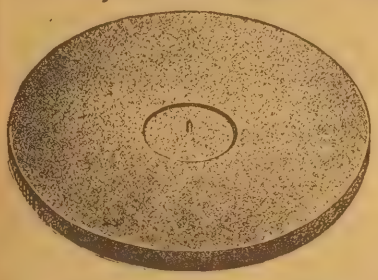

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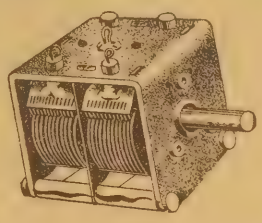

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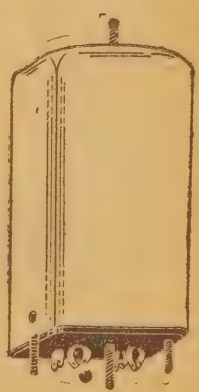

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PRINTING PAPER FOR ENLARGING

This month we detail some of the types of printing paper you will encounter when you commence enlarging. There is also a discussion on one of the most serious limitations of practical photography—the distorted tone range introduced by normal paper printing methods.

by Philip Watson

SO far the only type of printing paper we have discussed in these articles is the contact type or what is sometimes known as "gaslight" paper. A more correct name would be chloride paper, since silver chloride is the light sensitive salt used in the emulsion. Characteristics of this type are: Low sensitivity, high contrast, rapid development, and a pleasant bluish tinge in the blacks.

The low sensitivity of these papers makes them unsuitable for enlarging since the amount of light available is limited by the efficiency of the optical system. The lenses here are such that very much less light will reach the printing paper than would be the case in contact printing, and this brings us to the consideration of other types of papers.

BROMIDE PAPER

The most popular type of enlarging paper is the bromide type, so-called because the emulsion uses silver bromide as the sensitive salt. By comparison with the chloride types this emulsion is characterised by a higher sensitivity, a lower contrast, a longer development time, and a more neutral black which lacks the slightly bluish tinge.

The sensitivity is many times greater than the chloride type and, in fact, approaches that of a slow film, it being possible to use bromide paper in place of film by giving exposures in the order of 1/25 at f3.5 in bright sunlight. As a matter of interest this is one of the systems employed by "while-you-wait" photographers at holiday resorts, the resultant paper negative being copied, while still wet, to produce a positive on a second piece of bromide paper.

This high sensitivity also means less illumination in the darkroom and a deep orange or a yellow green safelight is required, such as the Kodak type 0 or 0A respectively. Due to the peak sensitivity of the eye in the green region of the spectrum the later type gives the greatest working convenience. Although less light can be used than with the contact types it is still much more than is permissible for films and there is no reason why the level should be reduced to dingy and uncomfortable proportions.

SOFTER PRINT

Because of the lower contrast, a negative which just suits a contact paper will produce a somewhat softer result on bromide paper, although the increased contrast brought about by the use of a condenser enlarger will often offset this or, alternatively, a "harder" grade of paper may be used. The best approach is to develop your negatives to suit the type of paper and the printing process you intend to use the most and, when variations from this are necessary, they can usually be accommodated by selecting the correct grade of paper. Thus negatives developed to suit enlargement by diffused light may be too contrasty when printed on a normal grade of contact paper, but will be satisfactory on one grade softer.

The development time, though longer, is not inconveniently so, being from two to two and a half minutes at 68 degrees compared with the 30 to 45 seconds for chloride papers. The neutral black is not a disadvantage in itself, but incorrect handling, particularly under-development, can easily change this to an unpleasant greenish tinge.

CHLORO-BROMIDE

A third type of paper is the chloro-bromide type which, as its name implies, uses a combination of both silver chloride and silver bromide salts in the emulsion. According to the ratio of the two, so the emulsion will exhibit characteristics somewhere between the straight bromide or chloride types. Usually the characteristics are more like those of a bromide paper, though somewhat slower, and have similar development and safelight requirements. The main feature of these types is the ability to achieve a variety of tones such as sepia, &c., by the use of special developers or sometimes by simply varying the exposure and development times. In general, these must be regarded as special types and hardly suitable for the beginner.

Another type which promises a number of advantages but which, unfortunately, has made only a brief appearance on the Australian market, is the variable contrast type. This is similar to a bromide paper in most respects but is available in one grade only, the contrast being varied by the use of blue and yellow filters.

The paper really carries two emulsions, a low contrast one somewhat softer than the softest grade normally available and a high contrast one extending a little farther than usual in the opposite direction. The low contrast emulsion is mainly blue sensitive and when all the exposure is made by blue light this emulsion only will be used and the result is a low contrast print.

The high contrast emulsion is yellow sensitive and when all the exposure is made by yellow light the result will be a high contrast print. In practice various degrees of contrast can be obtained by printing through a series of filters, either blue or yellow. Further, it is possible to obtain any intermediate degree of contrast by making part of the exposure through the blue and part through the yellow filter, the ratio of the two exposures governing the exact degree of contrast obtained. Thus a negative which appears to require a grade intermediate between those normally available would be easily accommodated by this system.

Unfortunately there are no types of this kind at present on the Australian market and there is no immediate indication of when they will be available. However, it is to be hoped that they will eventually be on sale in local shops, since they offer so many advantages to the amateur and professional alike.

PAPER GRADES

Most bromide papers are available in at least four grades of contrast and in some cases five, but, unfortunately, there is no standardisation of grades and the No. 2 grade of one maker may be similar to the No. 4 of another. For this reason it is not wise to switch haphazardly from one make to another, for the experience gained on one will not necessarily apply to all and you will have to start all over again.

Most papers are also available in a number of different surfaces, ranging from the glossy type suitable for ferrotyping, through the sheen and smooth types to the definitely rough variety. In contact printing, since the detail is small, it is customary to use a glossy surface to prevent the texture of the paper from intruding on the detail. For this reason most newcomers to the enlarging process will be unfamiliar with other types and may be in some doubt as to which to use. In this you can be guided only by your personal taste, but it is a good plan, if in doubt, to select the less obvious surface, such as a smooth lustre, rather than one of the coarser types, which are best reserved for special effects by those who know how to use them. Glossy surfaces are usually used when the print is to be used for block-making.

PAPER WEIGHTS

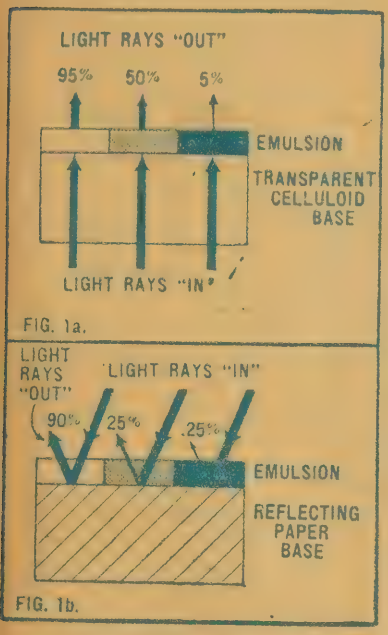
Another point to be considered is the thickness of the paper base, it normally being available in two grades or "weights." Small prints such as contacts are normally printed on single weight, but for larger prints the double weight is more suitable, as there is less tendency to curl on drying. It is also possible to obtain the base in other than white, such tints as cream and ivory being useful for special effects. However, as with the surfaces, it is advisable to avoid these "specials" until such time

as you have mastered the more conventional types.

Before going on to describe the handling of bromide papers in detail we propose to discuss the major limitation of all printing papers, namely, the distorted tone range which they produce. We have chosen to go into this matter in some detail because it is one that is frequently overlooked, not only by the beginner, but also by the advanced worker. Also, although it is a limitation of the printing technique, it has a marked bearing on the illumination of the original subject and can, in fact, be regarded as the major limitation of the whole process of photography.

All methods of reproduction, whether of sight or sound, have their own particular limitations. These are often far greater than is generally realised, and the high standards so often achieved are frequently a tribute, not so much to the accuracy of the reproducing system, but to the personnel who operate them. Having learned the exact nature of these limitations, they know just what modifications must be made to the original before it can be successfully handled.

Photography, as a method of reproduction, is no exception. Admittedly it is extremely accurate in many respects and this has no doubt led to the belief that a photograph is a perpect reproduction of the original. Quite apart from the more obvious defect, such as lack of color, there are less obvious ones which prevent it from being anything like an accurate reproduction of even a black and white original. Thus the photographer who wishes to succeed must also have a clear picture of the limitations of his art and be prepared to allow for them.



These diagrams show the essential difference between the two methods of viewing photographs and how the reflected light method distorts the tone values. Transmitted light is the better method but is inconvenient.

In order to appreciate the cause and extent of this limitation, it is first necessary to realise that a photograph can be viewed in two ways, by reflected light or transmitted light. The reflected light method is the one we normally use and is the only one when an emulsion is coated on a paper base. When the emulsion is on a transparent base, as in the case of negatives or positives intended for projection, it is viewed by transmitted light. The properties of transmitted light are retained, even though the light may subsequently be reflected from a surface before reaching the viewer, as in the case of motion picture or slide projection.

BOTH METHODS

Now let us examine both methods of viewing in detail, which may be easier if we take a simple example. For a subject, suppose we have a chart divided into three areas of tone, the pure white of the paper base, reflecting, say, 95 pc of the light falling on it, a mid tone reflecting 50 pc, and a black reflecting only 5 pc.

Next we photograph this chart and produce a negative which, for the sake of explanation, we will assume is a perfect, though inverted, copy of the original tones. If we now invert these tones again, by making a positive on a transparent base, also without loss, we should have a perfect reproduction of the original tones. That is to say, the transparent portion will transmit 95 pc of the light, the mid portion 50 pc and the dark portion 5 pc. This condition is shown in figure 1a.

LIGHT REDUCTION

So far, then, we have achieved a perfect copy, but what of the effect of a paper base and reflected light viewing? These conditions are represented in figure 1b. Assume again that we have produced emulsion densities which are an exact copy of the original tones. Now we come to the essential difference between the two methods of viewing. With a paper base the light which finally reaches our eyes has had to pass through the emulsion twice, once on the way "in," to reach the surface of the paper, and again on the way "out," after being reflected from it.

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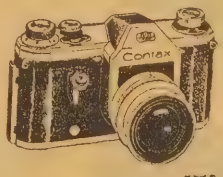

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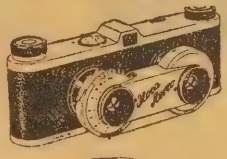

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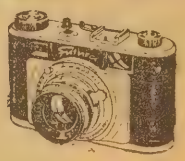

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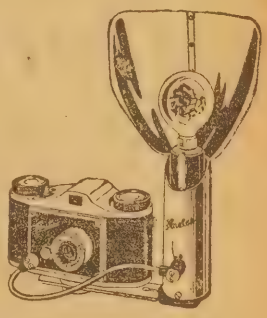

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This means, in the case of the mid tone, for example, that the light reflected from the base is only 50 pc of that striking the emulsion, while the light which eventually emerges from the emulsion is reduced by a further 50 pc, due to its second passage through the same emulsion. Thus the amount of light reaching the eye from this part of the print is only 25 pc of the light striking it and not 50 pc, as it should be, or, in other words, a clear case of tone distortion.

In the darker portion the effect is even worse, the amount of light reaching the eye being only 5 pc of 5 pc, or .25 pc, a much greater distortion than in the mid position. At the other end of the scale the effect is less noticeable, 95 pc of 95 pc being only a slight distortion.

If you care to, you can conduct a very simple experiment which will demonstrate this effect very forcibly. Take a negative which has a range of tones extending from clear celluloid right through to a very dense silver deposit and, preferably, having as many distinct tones in between as possible. Study it carefully and then place it, emulsion side down, on a piece of smooth white paper. It is essential that the emulsion and the paper be in absolute contact and this may be achieved by locking the combination in a printing frame. If you now examine the negative you will find that all the variations of tone in the denser portions have vanished, being reproduced as the same total black. This provides an excellent example of the same range of tones being viewed by both transmitted and reflected light.

TONAL RANGE

The effect when printing on paper is much the same, the range of tones present in the negative often being far too great to be reproduced in the print, the shadow tones being run together when correct density is achieved in the highlights, or the highlights being washed out when the shadows are printed correctly.

Thus it is clear that the mere fact of printing our picture on a paper based emulsion results in very severe tone distortion which is most apparent in the shadow portions of the picture. If we were to view all our pictures by projection this distortion would be eliminated but, as it is hardly likely that we will ever want to do this, we can only accept the limitation and do our best to overcome it.

And what can be done to remedy this defect?

In the case of the commercial photographer you will find that he overcomes most of the problem by careful attention to lighting. When working entirely by artificial light it is simply a matter of reducing the intensity of the shadows to a point which he knows, from long experience, will give the effect of normal shadows in the finished print. In other words he deliberately distorts the original subject by an amount which will just balance the distortion in the print, thus producing a picture which looks as though it was naturally lighted, which, after all, is the main objective.

Out of doors similar tricks are employed, reflectors frequently being used to direct additional light into the shadow areas, while at other times floodlights or flashlights are used to achieve the same purpose.

Quite obviously these devices can only be used when the shadow area is relatively small and it would be clearly impossible to treat, say, a landscape in this way. In any case the amateur will, in most cases, regard them as both costly and inconvenient so that other means must be found to achieve the same result.

Sometimes, by the use of suitable filters, it is possible to reduce the amount of light from the major highlights, such as the sea or sky, so that they are more in keeping with the density of the shadow areas. When this is not possible it may be necessary to hold back the exposure of the shadow areas during printing, a process sometimes known as "dodging."

DODGING

This is achieved by cutting a mask roughly to the shape of the shadow area which is printing too dark and using it to cover the appropriate portion of the printing paper during part of the exposure. Thus the exposure of this portion of the print is reduced and, if done correctly, it is possible to restore these areas to approximately their correct tone density. To prevent the mask from producing a hard outline it is kept moving slightly during exposure and may also be kept at some distance from the baseboard so that it is out of sharp focus.

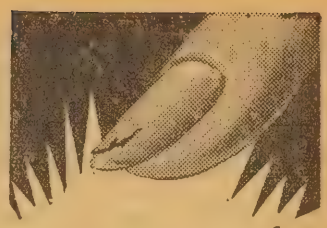
This method is probably the one most used by amateurs, and professionals, too, for that matter, but while it can be extremely useful it is often employed indiscriminately and without sufficient attention to what is really required of the print.

The point to keep in mind is that all these processes are intended to compensate for distortion due to natural limitations of the paper, not to introduce additional distortion. The case is very similar to that which is found in sound reproduction where it is necessary to balance one distortion, deliberately introduced, against another which is unavoidable. Thus the loss of bass response which is unavoidable in disc recording is compensated for by deliberately distorting the bass response on the amplifier or pickup by an equal but opposite amount.

It is hoped that the above explanation will give the reader a clear picture of the problems to be overcome, so that when he commences really serious work he will be better equipped to meet them. Next month we hope to deal with actual handling of bromide paper.

The normal hood used on reflex cameras is not always deep enough to exclude all unwanted light, particularly if the camera is in sunlight while the subject is in shadow. This can make focusing and composing difficult when the taking lens has to be stopped down to provide adequate depth of focus.

An auxiliary hood is extremely useful in such cases, and, for convenience, should be designed to fold flat when not in use. Suitable materials are cardboard, light plywood, or thin aluminium. Cut four pieces into long rectangles so that they may be assembled to form a square or rectangular tube of the same shape as the existing hood and large enough to slip neatly over it. The sides should be joined with surgical or masking tape to permit folding.



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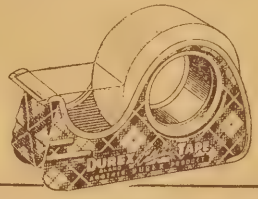

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HOW TO KEEP YOUR DRILLS IN ORDER

Don't throw away your drills when they will no longer cut, or put up with dulled edges. This useful article tells how to keep drills always in good shape.

NO tool is more difficult to grind accurately without proper equipment than a twist drill and although many have the knack of hand-grinding and getting a satisfactory result, it is not given to all of us to do this with complete confidence.

Any one who has thought of trying to make up a fixture or a machine for the purpose will have first closely studied a new twist drill and must have profoundly admired the beauty of its form, the elegant curl of its flutes, the glints of light by which the relief along the length of them is revealed, the scroll-like formation of its head, which certainly deserves a polish to equal the lustre of its skirts, and the classic contours of its trailing edges which contrast with the austere straightness of its cutting edges, all combining to make it a most efficient tool in the workshop.

A SUPER TOOL

Where should we be if this superb tool had not yet been invented? Drilling holes would, indeed, be a very laborious process.

Some handymen, not content with the primitive method of sharpening worn drills by hand, may have attempted to design a fixture by means of which their drills might be restored exactly to the perfection of their original profile and will then have come up against the geometrical intricacy of what I might term—to coin a phrase—the spiralated appearance of its head, which, of course, is not a true cone.

I have made three machines intended to reproduce the required shape, but each of them has been a failure. Apart from any question of the geometry being right or not, there were several reasons for my disappointment, of which lack of rigidity was probably the chief one.

It is extremely difficult with an apparatus having the nature of a "trial installation" to avoid backlash, distortion, and, worse still, deflection of the drill under the load imposed by the grinder, particularly in the case of small drills.

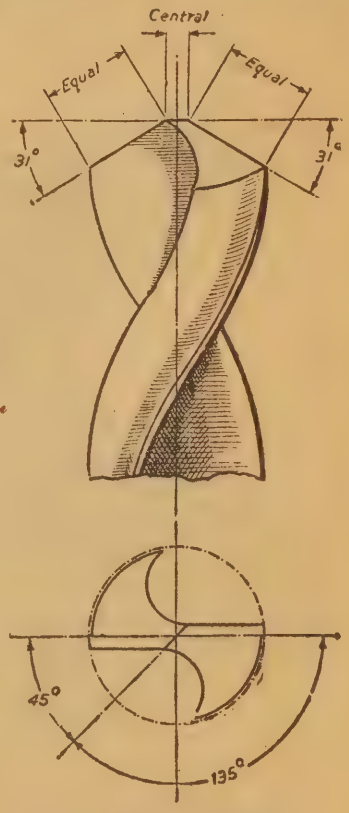


Fig. 1—Cutting-edge angles.

In some designs it is not easy to set up a small drill so that the cutting edge is precisely in its correct relationship to a chosen diameter of the grinding wheel, and any design which does not allow for dressing both sides of the head of the drill at one setting without adjustment—needing rotation of the drill through 180 degrees to reset it for grinding the opposite side—should be rejected. It is difficult enough to keep the drill point precisely coincident with its longitudinal axis without complications of that sort.

It is to be understood that the emphasis in this article is on the maintenance of small twist drills such as are normally to be found in the average man's equipment. The difficulties will tend to diminish, of course, as the drill diameter increases.

It is possible to resharpen and reset small drills, from the very tiny ones up to ¼in diameter or so, to a standard which is entirely satisfactory, without a machine of any kind, and the design of a clamp fitting, simple to make is the subject of this article.

It is advisable, however, as a preliminary, to make clear the basic requirements in respect of the angles, reliefs and other features, the importance of which cannot be overlooked if one wants one's drills to perform effectively and efficiently.

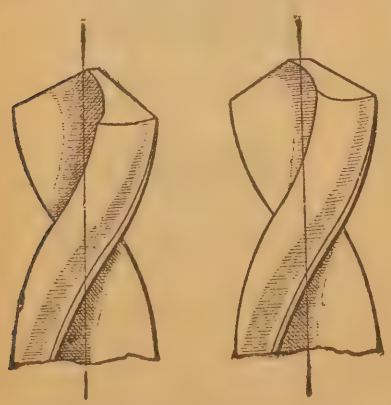
CUTTING EDGE

There are three cutting edges to a twist-drill, as can be seen in Fig. 1: The two radial edges and the edge at the apex. The edge at the apex is generally at an angle of 45 degrees, as indicated in that figure. If the drill is ground correctly, its head will look exactly as shown, but there are plenty of ways in which one can go wrong, and Figs. 2 and 3 illustrate two of the more common results of incorrect grinding — results which, unfortunately, are so easily obtained when grinding by hand, especially when the drills are small ones.

In Fig. 2 the point is not central and the cutting edge angle on the right is more acute than that on the opposite side—two faults. In Fig. 3 these faults do not appear, but the clearance behind the cutting edge is non-existent. This drill would, therefore, ride on its trailing points.

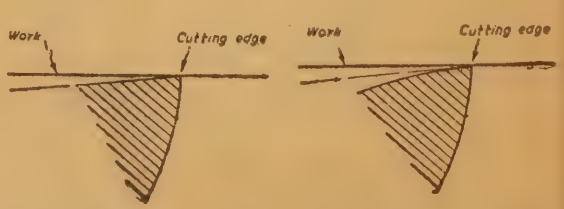
Fig. 4 illustrates the result of grinding the point so that the central cutting edge is at right angles instead of at 45 degrees to the side edges. This formation will be found to be noticeably less efficient in cutting speed.

The drill shown in Fig. 2 will not drill a hole true to size because its point is offset. The drill in Fig. 4 will not cut as rapidly as it should, while the form shown in Fig. 3 will not cut at all. The shape shown in Fig. 1 is most important and to produce it by hand-grinding requires not only considerable skill but not a small measure of luck as well, if the drill is a small one.

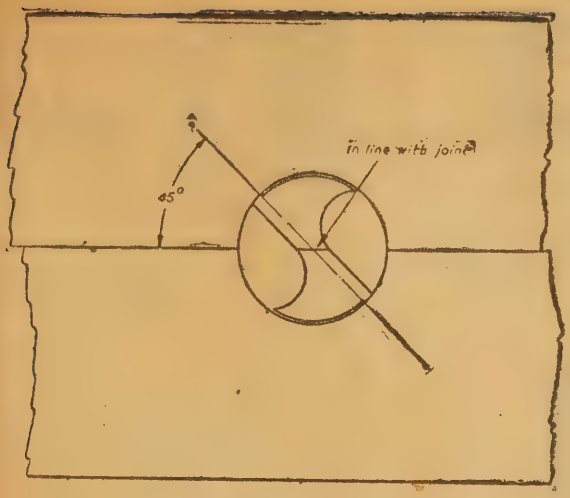


Figs. 2 and 3.—Results of incorrect grinding.

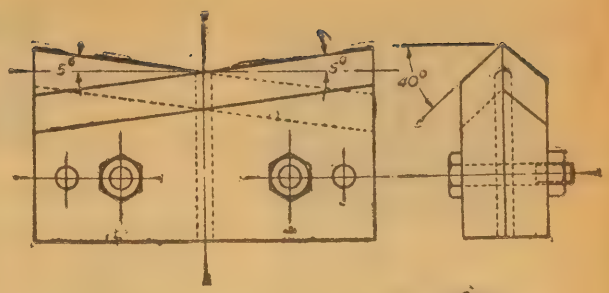
Fig. 4—Cutting-edge at right angles.

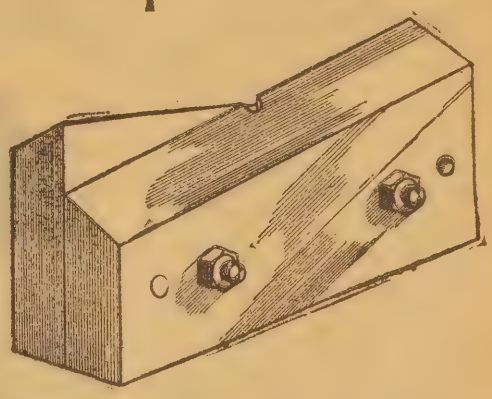


Figs. 5 and 6.—Diagrams showing angles of incidence.



Above—Fig. 8.—Showing the angle for mounting a drill in the clamp.





Right—Fig. 7.—Simple two-piece clamp for holding twist drills for sharpening.

ANGLE OF INCIDENCE

It will be clear from Fig. 1 that the direction of grind should produce an angle of 45 degrees at the centre. In side elevation, looking along the length of either of the side cutting edges, it is obvious that the head must make an angle of incidence to the work, as a plane-iron or a chisel does, as shown in Fig. 5. If the cutter were flat on the work it would only skid across it, but if the angle is too great, the leading edge will be weakened.

Many more points will occur to the reader who studies the matter, and he will probably reach the conclusion that only a lucky chance could give the perfect form when grinding by hand, the requirements seem to be so exacting. The question is, then, what simple appliance could be made up to help to control the operation?

It must be of a kind which supports the drill properly to eliminate all deflection, and its design should allow both sides of the head to be dressed at one setting, by alternate grinding strikes to one side and then to the other.

SHARPENING CLAMP

Now, for small drills it is permissible to grind at a tangent, giving the bevelled form of edge which is shown in Fig. 5. This is because the smaller drills are not strong enough as struts to accept a heavy feeding load, where a larger one can withstand greater pressure. In the latter case, the cutter bites into the work with deeper indentation and the relief behind the leading edge must, in consequence, increase progressively, as shown in Fig. 6, otherwise the torque increases undesirably.

So much more contact would be made with the combination of a deep feed and a plain bevelled edge. The reduced penetration, due to the comparatively light feed, is therefore the justification for using a bevelled grind on small drills. It is then permissible to make use of the very simple type of clamp illustrated in Fig. 7.

It consists of two pieces of steel, suitably bevelled, dowelled and bolted together. A hole is drilled vertically to receive the drill to be sharpened. The important surfaces should be ground flat, and it is very desirable, of course, that they should be hardened. It is a requirement that the drill be firmly fixed in the joint, and so a piece of paper is sandwiched between when drilling through the clamp. A new drill should be used for this operation to ensure that the hole in the clamp is of the correct diameter. On removing the paper there will be the required grip so that the drill to be sharpened will be held quite firmly in the clamp.

The clamp has a bevel of 40 degrees in end view; this will produce the required angle of 31 degrees for the slope of the leading edges of the drill. In front elevation, the clamp is bevelled at an angle of 5 degrees, which produces a clearance of about 3½ degrees, measured normal to the cutting edge, because the drill is mounted in the clamp at 45 degrees, as shown in Fig. 8.

The drill to be sharpened is set up so that its point is slightly proud, and is then dressed by rubbing a No. 149 carborundum pocket hone over each surface alternately. This stone is 3in x 7-8in x 3-8in thick, by the way, so the stock out of which the clamp is made is preferably 3-8in or more in thickness so as to give adequate land for the stone, then the stone will be under proper control as it rides up and down the slopes. It is best to use a new stone so that you know its faces are truly flat, an old one has generally worn a bit concave.

FOOLPROOF

Always provided that you have drilled the hole in the clamp quite centrally, there is nothing that can go wrong with your sharpening operation. The angles will be the same on each side, the point will be in the middle, and the relief will be equal on each side, for with this device there can be no distortion of the drill due to the bite of the stone.

Another advantage is that the drill can be set up in the clamp correctly without much trouble, because one

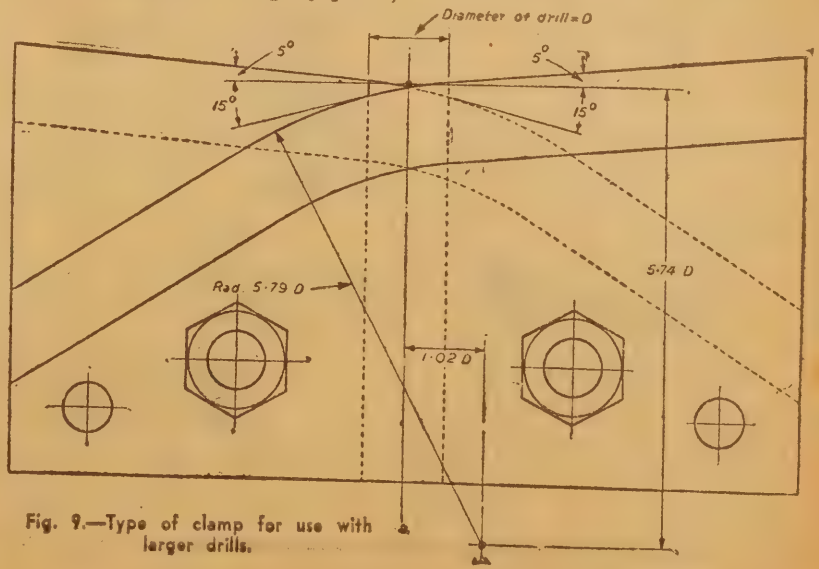
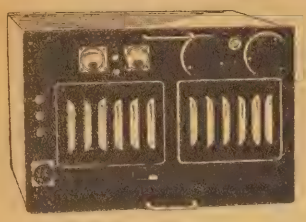


Fig. 9.—Type of clamp for use with larger drills.



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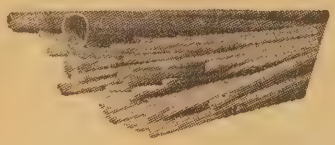

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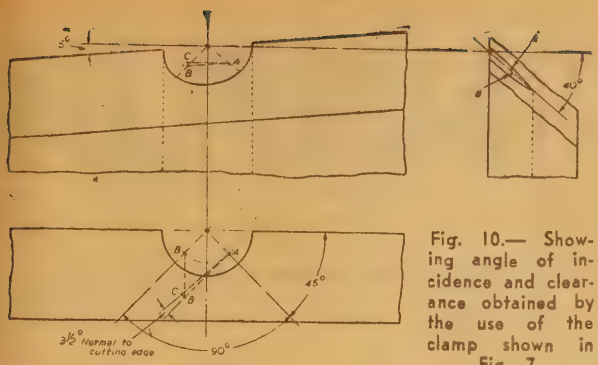

Fig. 10.— Showing angle of incidence and clearance obtained by the use of the clamp shown in Fig. 7.

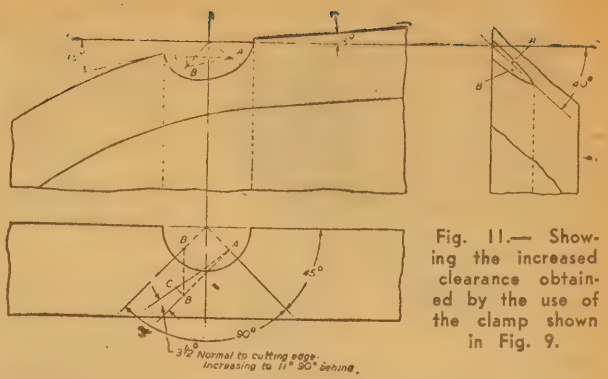

Fig. 11.— Showing the increased clearance obtained by the use of the clamp shown in Fig. 9.

can see quite easily to line up the centre cutting edge with the division on the clamp; even very small drills can be set up accurately if a magnifying glass is used. Furthermore, the work, in this case the head of the drill, is in full view all the time, which can hardly be said of it when using some machines having articulated headstocks.

LARGER DRILLS

When dealing with larger drills it may be necessary to provide the additional clearance demanded by heavier feed loads, and Fig. 9 illustrates the type of clamp which is then required. The radius shown provides a tangent at 5 degrees at the front and at 15 degrees at back, the dimensions for the arc being given in terms of the diameter of the drill.

It will be agreed that it is hardly practicable to form this arc precisely for drills less than about 1-8in diameter; a good compromise is to make the clamps with the two angles joining at the centre line of the hole and then carefully rub off the corner at their intersection to the approximate radius required.

Figs. 10 and 11 compare the relief actually obtained with clamps made to Figs. 7 and 9 respectively, and show the advantage of the arc. In both figures, A is any point on the cutting edge. At a station 90 degrees lower than the point A, and if B is 5 degrees lower than the point A, and if the angle made by the line AB and the horizontal (i.e., the work) is projected, it is found that the cutting edge makes an angle of incidence to the work of 3½ degrees while the tailing point of the drill, which is in the vicinity of B, has a clearance of 5 degrees.

In Fig. 11, a similar projection shows the angle of incidence to be 3½ degrees, as before, but the clearance at B is now 11 degrees.

MODEL MAKERS

Model makers are likely to be interested in the very tiny drills down to No. 68, or even smaller; for these the clamp shown in Fig. 7 will be found entirely satisfactory.

The main disadvantage of the method described is that a separate clamp is required for each diameter of drill—that is if one wishes to be really exact, but, on the other hand, these clamps can be made up relatively quickly, and it is not long before one has accumulated a number of them sufficient to deal with the range of sizes which need reconditioning most frequently.

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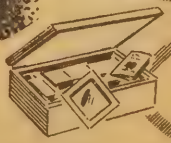

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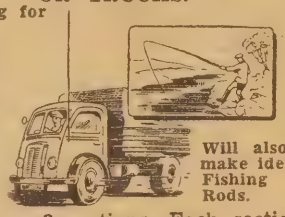

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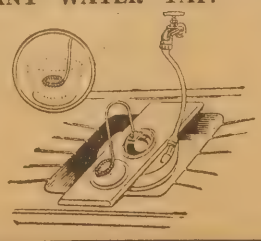

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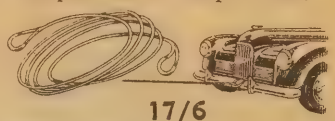

17/6

ENGLISH WOLF ¼" ELECTRIC DRILLS. BRAND NEW

230 VOLT

Limited quantity available.

£11/2/-

Be early they won't last long.

ARMY FOCUSING TELESCOPE.
Easily converted for use on dumpy levels.

Can be used as a rifle sight. Excellent magnification. **£4/19/6.**

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Make yourself a Battery Charger.

12v 2 amp 30/-
6v 5 amp 39/6
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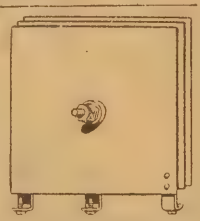


BRAND NEW AIR COMPRESSOR
2.2 cubic feet, will pump up to 75lb.

Never before at this price

Ideal for spraying.

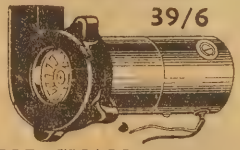
£11/15/-

Will work off 1hp motor.

ENGLISH MOTOR AND BLOWER, 24 VOLTS

39/6

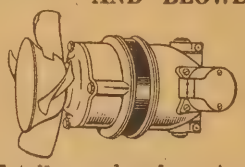
Will Work off 32-volt Lighting Plants.



IDEAL FOR SMALL FORGE.

Ball and socket inspection mirrors, 8/6. Ideal for engineers. Car dimmer switches, 12/6. Bakelite 3 draw telescopes, 15/-. 300 watt vernier variable resistors. £4/15/-. 2 negative and one pos. projection lenses, 25/- set. Brand new vernier calipers fitted with depth gauge, 25/-.

LARGE 12-VOLT AC-DC MOTOR AND BLOWER



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£4/10/-

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Brand New Head-band Type Magnifiers

Made in England
Optically ground Lenses.

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Ideal for instrument makers, watchmakers, tool makers, medical work, chemists, etc.

R.A.F. BOMB HOISTS 175 TO 1 GEARING. WORM DRIVEN. CAN BE HAND OPERATED OR MOTOR DRIVEN.

Fitted with quick release clutch.

Cost £35.
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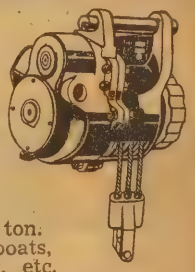
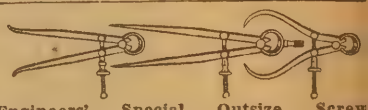


Will lift ¾ ton. Ideal for boats, garage work, etc.



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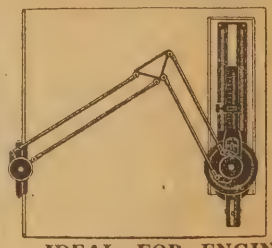

Bakelite Base. Draws Angles Parallel or Vertical.

70/-

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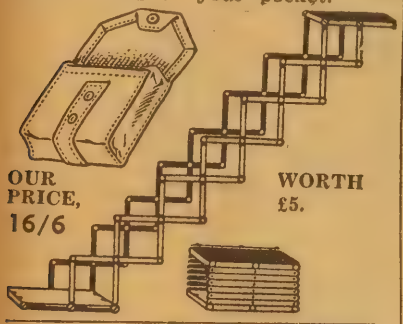
VICTORIA STREET. Phone: FJ5904.
ALTERATION WITHOUT NOTICE.

Gents' chrome plated wristlet watches fitted with chorme expanding band **£4/4/-**.
Brand new sports binoculars, screw focusing **35/-** pair.
French motor cycle goggles fitted with sun visor **16/6** pair.

GENUINE ARMY PERISCOPES
Remember, there is going to be a Royal visit soon. See over any crowd. Fits in your pocket!



OUR PRICE, 16/6 **WORTH £5.**

American Vacuum or Air Pump.

Builds up air pressure to 30lb. at 1000 R.P.M. Develops up to 120lb. of hydraulic pressure, will pump 7½ gallons S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems **£3/15/-**

SPECIAL DISPOSALS METER OFFER

0-1 milliamps, 2½" dial .. **37/6**
American Weston 0-50 voltmeters .. **42/-**
Weston 0-50 volt 0-100 amps combined .. **£3/10/**
English 50-0-50 Ammeters .. **32/6**
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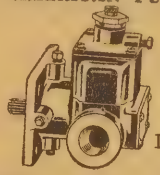
WATCHMAKERS AND INSTRUMENT MAKERS

14/9

English Tweezers **5/6**
English Pin Vices **6/6**
Eyeglasses .. .. **6/6 and 8/6**
Extra Strong double lens Eyeglass 15/-
Small Screw Drivers, 2/6. Large, 3/6.

ROTARY AMERICAN PUMP

USED BY THE R.A.F.



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STAINLESS STEEL VANES

400 galls. per hour **55/-**

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DALTON COMPUTORS IDEAL FOR AERO CLUB, A.T.C., ETC.

Only Limited Stocks Available. Be Early.

45/-

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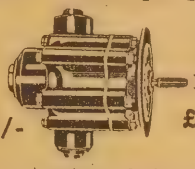

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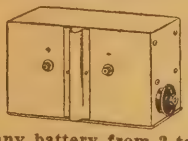
Useful for tractors, hoists, presses, etc.

COMPLETE BATTERY CHARGER

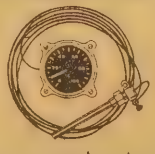
Fitted with brand new English Selenium Rectifier.



Works off 230v. A.C. Household Supply.

Charges any battery from 2 to 6 volts at 5 amps, £6/15/- complete.

BRAND NEW REMOTE CONTROL TEMPERATURE GAUGES.



35/-

Ideal for cars, tractors, boats, ovens, etc. Never before at this price.

Telephone FJ5904

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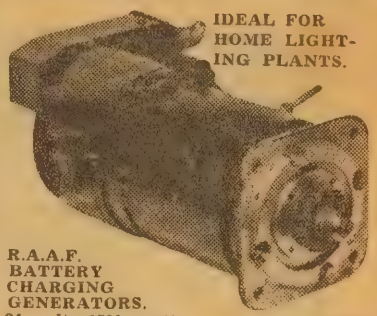
Large size air compressors 8.5 cubic feet 150 lbs pressure. Ideal for garage work, spraying, etc. **£39/10/-.**



IDEAL FOR HOME LIGHTING PLANTS.

R.A.A.F. BATTERY CHARGING GENERATORS.
24 volt, 1500 watt **£15/15/**
Brand New English Lucas, 12 volt or 24 volt, 500 watt **£10/15/-**
Brand New 24 volt, 1000 watt .. **£13/13/**

CELLULOSE ACETATE SHEET
takes the place of celluloid. Will not discolor, non-inflamable, replace those broken side curtains. Can be sewn or cemented into frames 24 x 52. 20 thousandths of inch thick. Sheet **32/6**

Special Special Special

Music box units complete with wind up motor. Make yourself a musical cigarette box, music box, etc. Can be fitted into many articles, **30/-**. Also enclosed type for fitting into dolls, teddy bears, work baskets, etc. **35/-.**

SPECIAL OFFERS

Army despatch rider's goggles **9/6** pr. English car parking lamps **15/-** or **27/6** pr. Brand new telescopic car radio aerials 8ft. 6in. long, fold down to 13½" **59/6.** DPDT Aerial change-over relays, ideal for transmitters **22/6.** 3½" parabolic reflector mirrors **15/-.** 10½" **39/6.** Build yourself a spotlight or useful for photographic work. Dental handpieces, useful for engraving, **25/-.**
English interchangeable blade surgical scalpel, handle and 3 blades, **10/6.** Ideal for hobbyist.
Frogman swimming fins **45/-** pair.
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Army Folding Bolt Cutters .. **15/-**
Brand New English Headphones, **17/6 pair.** American Feeler Gauges, **8/6**
12-volt Generators, 250-volt output at 125 mils; perfect B. supply for any radio or amplifier from 12-volt accumulator, **£4/15/-.**
Hard to get Truck and Tractor Ring Spanners. King Dick 1 1/16" x 1⅛" **35/-**, 1 1/16" x 1¼" **37/6.**
Half Moon Ring Spanners ¼" x 3/16" Whit. **10/6.** ¼" x 5/16" Whit. **12/6.**
5/8" x 9/16" S.A.E. **12/6.** ½" x 7/16" S.A.E. **9/6.** King Dick S.A.E. Ring Spanner Sets, 6 sizes **39/6.**
Shaded pole induction motors made by Hoover of England, 230 volts A.C. Constant speed 1200 r.p.m Very silent running. Ideal for cine projectors, grammo motors, hobbyists, instrument makers, etc., **£4/19/6.**

"Soundmaster" Radio-Recordergram.

Here's something really wonderful to spend that surprise Christmas cheque on — the Sensational "Soundmaster" radio-recordergram. Imagine all the fun your whole family will get from this one entertainment unit that offers you three different sorts of amusement. The gramophone will play your favorite records—at three speeds, the usual 78 r.p.m. and the sensational new microgroove records at 33 1/3 r.p.m. Both play with the superb tone you associate with the finest quality radiograms. Also you can get your beloved radio programmes on the first-rate quality radio. It's a Tape Recorder, too! Till you've had a recorder in the home you just can't imagine how much entertainment it means. Record with amazing clarity, without scratch or the least background noise, any music, party fun, conversations, singing and so on. You can plug in the mike to record from life, or the machine will record instantly, at the flick of a switch, whatever is playing on the radio or gramophone. You can play back instantly, keep indefinitely, or it will automatically erase for re-recording. The family can record radio programmes you won't be there to hear.

The "Soundmaster" Radio-recordergram is a magnificent piece of furniture for your home, in a superb cabinet of fine Italian figured veneer. Full price is £211/15/6.

Also ask for a demonstration of **our latest NEW model**—The Super Soundmaster Radio-Recordergram with the imported English "Soundmirror" Tape Recorder and Collaro 3-speed Record Changer. An exceptionally high quality amplifier **and** powerful dual-wave radio unit. All in a glorious cabinet.

TO CLEAR

6 ONLY. Wirex wire recorder decks. Complete with gramophone turntables, £62/10/-.
1 complete wire recorder, £85.
Quantity tape recorder motors, S.R.I., £3/19/6.

Large stocks of English and German tape always available. **Empty plastic and steel spools available from stock.**

MAGNETIC SOUND INDUSTRIES (AUST.)

1st Floor, 590 George St., Sydney, Crystal Palace Arcade. **OPP. REGENT**
Open Saturday mornings. **Phone M3393** Laboratory, XY5063.

MAKING AN ELECTRIC MOTOR

(Continued from page 59)

ing layer can be formed with very little trouble.

For the field coil, wind on four layers of 35 gauge enamelled wire, each layer being ½in wide. Incidentally, the gauge of the wire is not particularly critical. It may be several gauges different from that used in the original, either SWG or B and S gauges, and not make any worthwhile difference to the performance of the motor. Between each layer of wire place a layer of brown paper or cellulose tape. Not only will it insulate successive layers from each other, but it will make the winding job easier. Finally, put two layers of paper over the last winding to hold it firmly in place and protect it from damage.

The two sections of the armature are assembled around the armature shaft and held in place by the insulating paper together with the armature windings. As the motor is so very small, friction is sufficient to hold the parts in place.

THE COMMUTATOR

Wind two or three layers of paper or cellulose tape around the other end of the armature shaft. After winding the armature, the ends of the wire are bound in place over the paper on opposite sides of the shaft to form a simple commutator. Ordinary sewing cotton may be used for this.

On each side of the armature wind four layers of 35 gauge wire, taking the same precautions with the insulation as with the field coil. There is one point to watch particularly in winding the armature, and that is that both sides of the winding must be in the same direction If they are reversed the motor certainly will not work.

The relation between the armature and the commutator is important if the motor to run properly. Best results are obtained if the two pieces of wire which form the commutator make contact with the brushes when the armature is in th vertical position. You will note, of course, that the brushes do not make contact with the commutator throughout the full rotation and, therefore, the motor does not develop the full power of which it is capable. This really doesn't matter much because our main aim in making the motor is to demonstrate the principle of operation.

The brushes are simply two pieces of 35-gauge wire, mounted under a nut on the baseboard. Clean the enamel off their full length with the aid of a piece of emery cloth, or scrape it off with a knife. Incidentally, where emery cloth is available, it is always advisable to use it for cleaning wires rather than a knife since there is less danger of scraping away the copper as well as the enamel.

All that remains now is to connect the various wires into the circuit. One wire from the field coil connects with one terminal post, while the other goes to one of the brushes. The remaining brush connects with the second terminal post. It is as simple as that! If you trace

(Continued on Page 95)

ENGINEERING CORRESPONDENCE COURSES

THE AUSTRALIAN TECHNICAL SCHOOLS, 3 Jamieson Street, Sydney.

have trained students — by Correspondence — since 1923 — in Engineering Subjects — with MARKED SUCCESS — from all walks of life. (Rural, Farms, Stations, Factories, etc)—from all parts of Australia — and from New Zealand, New Guinea, Fiji, Malaya, Borneo, South Africa, Nigeria and Ceylon.

Special Correspondence Courses— Now Available!

Diesel Engineering
Motor Car Engineering
Workshop Practice
Steam Engine Driving

Many successful Correspondence students have written and thanked us for what we have done for them. Here are a few extracts from their letters:

DIESEL OPERATOR	"I now have a position on a Diesel plant at good money. Your School was responsible for me being able to fill that position."
CHIEF ENGINEER	"I was recently appointed Chief Engineer to a Factory and Trading Co. The plant includes 5 Diesels and 4 Electric Generators."
SERVICE MANAGER	"Since taking the Motor Engineers' Course I have been appointed Service Manager for the International Harvester Co. I thank you."

MOTOR MECHANIC

"The Course has been a great help in my work. I have been successful with jobs which have beaten other mechanics.

POST COUPON FOR FREE BOOKLET

Write Plainly

The Supervisor (R.H.) 252
AUSTRALIAN TECHNICAL SCHOOLS,
Assembly Hall, 3 Jamieson St., Sydney.
Please send me (without obligation) your FREE ENGINEERING LITERATURE—ALSO send me full particulars and advice about your Correspondence Course in—

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Name .....

Age ..... Occupation .....

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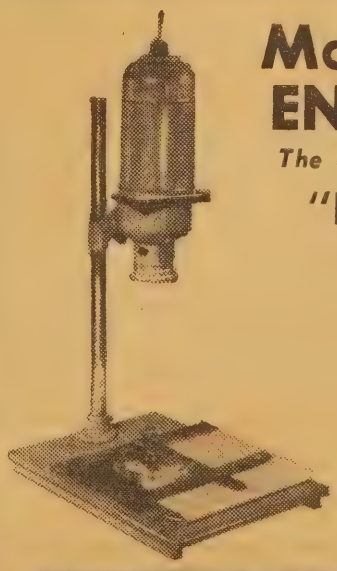

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DEALERS: Enquiries invited to Beaumaris Hardware Co., 22 Dalgety Rd., Beaumaris

SHORT WAVE NOTES BY RAY SIMPSON

SCHEDULE OF POLISH BROADCASTER

Direct from Radio Polskie we have received some interesting information regarding their new schedule which has recently come into operation. They are now transmitting only on 6.115 mc and give their first program at 8 am and this is repeated at 8.30 am. Program number two comes on the air at 2.15 pm and this is repeated at 3.30 pm.

THE station makes the following observations: "We begin our first and second daily programmes with the latest International and Polish news. Our news broadcasts contain many items rarely appearing in your local Press and radio.

"Our first program continues with the commentary of the day and is followed by some popular Polish music. You can then hear a description of some of the many interesting changes occurring in Polish life today. We end this program with some lively Polish dance tunes and songs.

"After the news, our second program presents a commentary on some topic of vital interest to our North American listeners. This is followed by our word and music interlude, in which we play the music of Polish composers, at the same time giving our listeners a background of the selections they hear. We close our transmission with messages and comments from American prisoners of war in Korea.

"In our Saturday features, 'Chat With Listeners' in program one, and the Letter Box in programme two, we answer our radio mail, play request musical numbers or discuss some topic which has particularly interested a correspondent. On Sunday, in our second program, we schedule a talk on some aspect of American culture.

"We invite comments and criticisms from our listeners. Do write us often."

The address for listeners' letters in connection with the above should be sent to Polskie Radio, English Language Transmissions to North America, Aleja Stalina 21, Warsaw, Poland.

VLT, PORT MORESBY

WE understand that many of our readers in Northern Queensland and, of course, those who reside in Papua and New Guinea, depend to a large extent on the transmissions from VLT in Port Moresby. The latest schedule of this station will therefore be of interest: VLT7, 7.28 mc, Mondays to Fridays, 1.15 to 10.45 pm, 6.45 am to 8.45 am; Saturdays, 6.15 pm to 11 pm and 6.45 am to 8.30 am; Sundays, 6.15 pm to 10 pm and 7.45 am to 11 am. VLT9, 9.52 mc, Mondays to Fridays, noon to 1.45 pm and 4.0 pm to 6 pm; Saturdays, noon to 6 pm; Sundays, noon to 2 pm and 4 pm to 6 pm.

NEW STATIONS

WE recently heard a new German station operating on 9.81 mc from around 7.30 pm, giving what was evidently a test program, as at frequent intervals they announced in English, "This is Frankfurt on Main, carrying out experimental tests for communication purposes." Probably this station is to be used for purely telephone purposes, and it is not likely to be used for broadcast purposes.

The Voice of America station at Honolulu has recently opened a new channel on 6.195 mc, which is heard at excellent strength daily at 7 pm. Over the past few years Honolulu has used many different frequencies and this latest one seems one of the best at our location and is possibly heard well elsewhere.

SHORT Wave Notes for the March issue are due on February 9. For the April issue they are due on March 8. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, NSW.

NORWEGIAN UNIVERSITY STATION

FOR some years now it has been the custom of the Trondheim, Norway Ukesenderen NTH to make a number of broadcasts at Christmas time. According to advice we have just received from overseas, this station was to be on the air as follows at the end of last year so this may enable you to identify a station you heard at the time but could not find in your station list.

They were to transmit on 7.21 mc and 9.54 mc, that is the same channels as used by the Tromso transmitters LLS and LKJ after these stations had left the air. This would make the broadcasts from around 8.0 am to 8.30 am and were to be daily during the period November 10 to December 2 and also on November 3 and 4. Power to be used was 400 watts.

SYDNEY-HOBART YACHT RACE

This annual event always provides some interesting reception and this last year was no exception as signals from both the yacht and Sydney could be heard for some considerable time after the start of the race. The shore station, VIS Sydney were using their normal channel of 6.405 mc while the signals from Kurrewa III could be logged on 6.23 mc.

For those who enjoy this type of reception we suggest they listen in at 5.0 pm daily when they can hear VIS calling Small Ships and on these occasions the replies can be heard on 6.28 mc which is the normal channel for small ships.

STATION ADDRESSES

YVQA	Radio Sucre, Calle Sucre 85, Cumana, Venezuela.
YVMS	Radio Universo Barquisimeto, Apartado 77, Barquisimeto, Venezuela.
OAX4G	Radio Lima, Avda Uruguay 355, Lima, Peru.
OAX4J	Radio Colonial, Apartado 1166, Lima, Peru.
CXA30	Radio Nacional, Ave. 18 de Julio 1764, Montevideo, Uruguay
HJCH	La Voz de la Victor, Apartado 565, Bogota, Colombia.
HJFB	Radio Manizales, Apartado 175, Manizales, Colombia.
HP5H	La Voz del Pueblo, Apartado 1045, Panama City, Panama.
XEBR	Radio Difusora de Sonora, Serdan 144, Hermosillo, Mexico.
4V2S	Radio Port au Prince, Govt. Rue de Centre, Port-au-Prince, Haiti.
TGDA	La Voz de Occidente, Independencia 8, Quezaltenango, Guatemala.

FLASHES FROM EVERYWHERE

YUGOSLAVIA: Some of our readers who have only a slight knowledge of foreign languages often find difficulty in identifying many of the Europeans who do not use English in their programs. They will therefore be pleased to learn that Radio Yugoslavia, as from December 1, broadcasts programs in English from 2.45 am to 3 am, and 5 am to 5.15 am daily, using a frequency of 6.1 mc. Programs in French can be heard from the same station from 5.15 am to 5.30 am and from 8 am to 8.15 am. Call letters for the 6.1 mc channel is YUA, while for their other outlet in the 31 metre band on 9.505 mc the call is YUC.

THAILAND: Thailand or Siam has been heard in Australia for many years now since the days of HS8PD, though their programs are not usually of any great interest to us, with the exception of the news in English. We learn from Radio Australia that the Thai overseas service, which is given on 11.91 mc, has improved very much lately, when they give the English program between 8 pm and 9.30 pm.

They also use 6.24 mc and 15.91 mc until 9.30 pm, the former being the best at our location, while the 11.91 mc outlet can sometimes be heard till as late as 10.30 pm. Quite often there is rather severe interference on this latter frequency.

ANGOLA: This Portuguese African colony has a large number of stations for its size and we learn from Sweden Calling DX-ers that there is a new station, CR6RP, operated by the Radio Club do Cuanza Sul in Novo Redondo and using a frequency of 4.932 mc. It has a power of 200 watts and is on the air from 4 am to 6 am.

There is another new one, CR6RK Radio Club do Sul el Angola, located in Lobito, and which uses 7.18 mc. This latter station has a power of 750 watts and takes the air from 9 pm to 10.30 pm, 2.30 am to 5 am, and 6 am to 8 am. There is also a new transmitter of Radio Club do Angola testing on 11.864 mc, with a power of 20 kw between 4.30 am and 6.30 am.

INDONESIA: Art Cushen, of New Zealand supplies some interesting information regarding the new station "Radio Andir," which operates on 7.165 mc. Art has received his verification from the station which was sent by Captain M. S. Tamini, Technical Director, from the station headquarters in Bandoeng.

The transmitter is located at Djakarta and is an RCA type, with a power of 7.5 kw, with beams on North-East and West of Java. This station is now also operating on 11.94 mc, and their schedule is 7.30 pm to 9.30 pm. The station advises that verification cards will shortly be issued from Djakarta, so if you have not yet received one, do not give up hope.

NEW GUINEA: Once again, thanks to Graham Hutchins' DX session from Radio Australia we learn that the Hollandia station "Radio Omroep Nieuw Guinea" state in their verifications that they have a very limited number of recordings in their library. They have requested the co-operation of short-wave listeners who may have any old records which they no longer require.

MISCELLANEOUS: The CBC are now using a new station CHLR for their European service on 9.71 mc; TAV, in Turkey, gives news in English at 10.30 pm, the frequency being 17.83 mc; PRB25, Sao Paulo, Brazil, can be heard on Sundays in New Zealand until 4 pm on 15.135 mc; Mogadiscio, in Italian Somaliland, has been testing on 7.24 mc between 3 am and 4 pm with light music and news in Italian at 3.30 am. It is reported that Fiji is to have a 500-watt transmitter in operation sometime this year; WRUL, in Boston, now give their address as 1 East 57th St., New York 22, NY, and also use the slogan "Voice of Freedom."

THE HAM BANDS WITH BILL MOORE

Amateur Radio stations scattered throughout the country have on occasions in the past provided a valuable secondary communications system in times of emergency. It is anticipated that in the proposed Civil Defence communications organisation, these stations will be co-opted to provide a stand-by system should they be required.

THE report of the work of the Federal Executive of the WIA presented in Amateur Radio on the subject of civil defence operation of radio amateurs is of extreme importance. It follows a motion endorsed at the 1951 Federal WIA convention that the executive should investigate civil defence proposals relative to amateur radio.

The Federal Executive met the Minister for Civil Defence, the Hon. W. S. Kent-Hughes, and outlined the value of amateur radio networks in civil defence and emergency work. It was intimated by the minister that his proposed bill for authorisation to form a skeleton civil defence system shortly to be presented to Parliament, would include radio amateurs in the communications section.

AUSTRALIAN RECORD

The Australian amateur has an excellent record in times of flood and fire but a problem here in Australia is to hold his interest in portable working during normal times. In contrast with America, where climatic extremes are experienced regularly, and amateurs are called upon to provide emergency communication, we rarely experience such conditions. The Australian amateur is in the unfortunate position of having on hand portable equipment that may be required for use only at yearly or even greater intervals. It is certainly uneconomic to tie up valuable equipment for such irregular use.

Many stations in vulnerable locations are holding equipment purchased at considerable expense. Perhaps civil defence operation will provide a use for such apparatus.

Immediately after emergencies it is possible to keep net stations interested in practice emergency working, but after a period interest must wane. The amateur is still prepared but prefers not to expend too much of his rare spare time on routine schedules.

There is one fortunate trend, and that is toward more and more portable and mobile working. This should prove valuable for civil defence operation. If development continues at its present rate, about 25 pc of Australian stations should be so equipped within the next few years.

Extensive preparation in civil defence operation by amateurs in the US is proceeding. Club groups in many of the cities are providing much of the impetus to the scheme, with a resultant increase in club membership, meeting attendance and club activity.

Most groups have designed special standardised equipment for CD frequencies, much of it for use on the 144 mc band.

The CD communications working can provide in normal times another interest for amateurs to practise portable working. The actual details of how amateurs can assist in the scheme will be awaited with interest. It will provide the hobby with a challenge, one that will most certainly be accepted, and we can be certain that the amateurs will chalk up another credit mark on their national service sheet.

Overseas Comment

THE ARRL is paying particular attention and offering assistance to the class of licensee in the US known as "The Novice."

Special broadcasts from WIAW are being made regularly on telephony and slow Morse in keeping with their 5WPM examination level. Periods have been set aside each evening for contacts to be made between old timers and novices.

It is anticipated that the 12 months licence currency period will provide the novice with sufficient experience to sit for one of the general class licences.

According to some W stations, their frequency allocation of 3700-3750 kc/s is being invaded by the KW gang who are interfering badly with their 75 watt transmissions. It is hoped that other licensees will reduce power when operating within those limits.

A special section of the "Sweepstakes" (similar to our Remembrance Day contest) has been set aside for the use of WN stations. The influx of new stations is so great that the ARRL expects the 100,000 mark will be reached this year.

Further operating privileges have been granted to English amateurs. Frequency modulation is now permitted on the 144 Mc/s band between 144.5 and 145.5 Mc/s, provided interference is not caused to other services operating in the band. Power is limited to that available to the licensee for amplitude modulation.

Pulse modulation is also permitted on the 2350-2400, 5700-5800 and 10,050-10,450 Mc/s bands.

Power shall not exceed 10 watts mean DC input and I kw peak power where the licensee is not authorised to use power exceeding 10 watts for amplitude modulation and 25 watts mean DC input and 2.5 kw peak power in other cases. Means shall be provided at the station to determine the ratio of pulse width to space width.

INTERFERENCE

Again the RSGB has taken up the matter of commercial interference on our bands as allocated at the Cairo conference with the GPO. The authorities, while appreciating the difficulties amateurs are experiencing, regret nothing can be done to improve the position until such time as the frequency table drawn up at the Atlantic City conference in 1947 is fully implemented.

Interference on the 7 Mc band is particularly troublesome, as can be noted by an inspection of that band any morning when European stations are audible.

American amateurs again welcomed a decision allowing an amateur to retain his tower at his home.

The Supreme Court of Pennsylvania decided in favor of George Lord, W3MKK, retaining his 32-foot aluminium tower erected at his residence. The Supreme Courts of Minnesota and New Jersey had previously given similar rulings in such a case.

The ARRL back in 1948 decided to act on behalf of Lord and had arranged for the ARRL general counsel to represent him.

The League now hopes that in view of the decisions in three States, that amateur radio equipment is a customary installation in residences, that it should be now settled law throughout the US.

A PRECEDENT

In view of the work entailed, one brief running to hundreds of pages, and the total cost approaching 10 000 dollars, the ARRL cannot hope to fight similar cases in the other 45 State Supreme Courts. Local officials, it is anticipated, will be bound to follow the mentioned precedents.

Arguments were essentially based on the fact that with 90,000 amateurs in the US and 120,000 in the world, most of whom operate from their home, amateur radio is a customary function of any residential area and interference with such privileges is not good in law.

The words of Justice Bell, of the Supreme Court of Pennsylvania, in delivering the opinion of the court, were truly eulogistic of amateur radio: "The importance of amateur radio in furthering science, in discovering the whereabouts of persons lost on land or sea, in furnishing and eliciting information of great value to our country and in spreading goodwill throughout the world can hardly be exaggerated."

Fred Phillips, VK2ZQ, produced from the archives a very interesting journal, a special complimentary issue of The Radio Experimenter and Broadcaster, published in July, 1924. It was devoted entirely to excerpts from the Governmental Wireless Regulations applicable to amateurs, experimenters and novices at the time. It is interesting to note the facilities available at the period.

Experimental licences were available for research and instructional purposes but unless the holder was specially qualified, were not endorsed for transmitting. All licensees, however, had to keep a chronological record of their work. They had to pass an examination or prove they were sufficiently qualified to hold an experimental licence.

AOCP REQUIREMENTS

The AOCP examination requirement, as listed anyway, is very similar to that today, but as everyone knows the technical section standard is very much higher.

Applicants had to be qualified as follows:—

(1) Transmit and receive Morse at a speed of not less than 12 words per minute.

(2) To adjust and operate low powered apparatus and have a knowledge of its working.

(3) Knowledge of the principle abbreviations and regulations laid down by the International Radio-Telegraph Convention.

When a person was so qualified he could operate an experimental station for transmitting purposes.

The following are the general conditions under which amateurs operated at the time.

The power (measured in the high frequency generator circuit) to be used in experimental transmitting stations shall not exceed 10 watts except in special circumstances, where it is shown to the satisfaction of the department that that power is insufficient.

The wavelength range of an experimental station shall be between 125 and 250 metres. The Postmaster may, where he deems it advisable, authorise the use of a wavelength outside of the specified range.

The use of licensed experimental transmitting installations shall be restricted to investigation, research or instructional purposes in wireless telegraphy or telephony.

The present regulations relative to interference to other services, working amateur stations only, secrecy of communications, all applied.

It is quite apparent that through the years regulations have to be varied to cover new techniques but we still enjoy one of the most liberal sets of regulations applicable to amateur stations.

North Coast Convention

THE third annual North Coast Convention of the NSW Division WIA will, as usual, be held over Easter, April 12, 13 and 14, at Urunga. The usual full and varied program has been arranged.

The Federal Convention of the WIA will, too, be held over Easter. The venue this year is Sydney, but it is not anticipated that the two functions will clash. It is a pity that Urunga is so far from Sydney, and that it will be impossible to show the interstate delegates the features of the convention.

Arrangements for the North Coast show are complete and are as follows:—

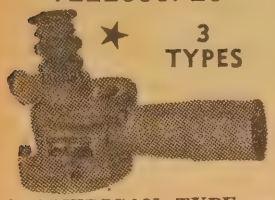
Opening on Easter Saturday and from 10 am to 1 pm registration will be in the hands of Bob Long, VK2MM, and Colin Long, at the "Do Me" shack, Urunga. At

Waltham TRADING Co.

AUSTRALIA'S LEADING DISPOSAL STORES

Branches at: 319 Swanston Street, 393 Flinders Street, } MELBOURNE.
Mail Order Dept. 319 Swanston Street.

PRISMATIC ELBOW TELESCOPES



★ 3 TYPES

1. AMERICAN TYPE
(as illustrated.) Extra wide field, cross-lines, color filters, approx. X8 magnification, as used by leading rifle clubs.
PRICE, £5.

2. ENGLISH TYPE
Large field of vision, highest quality lenses, approx. X6 magnification, worth £10.
OUR PRICE, £3 .

3. BRITISH MADE
Normal field of vision, sturdy construction, approx. X6 magnification.
ONLY £2/5/0.

Postage: Vic. 3/8; Tas, NSW, SA, 6/-; Qld., WA, 8/4.

HYGROMETER

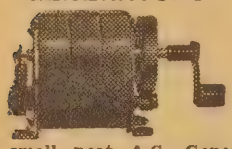
WITH CHART
For Temperature and Humidity Reading.

Suitable for

- FACTORY
- HOME
- FARM
- DAIRY

An Accurate and high class instrument having two thermometers with calibrated Fahrenheit reading scales.
PRICE 19/6
Postage: Vic., 2/-; NSW, SA, Tas., 3/-; Qld., WA, 3/9.

BELL RINGING GENERATORS



A small neat A.C. Generator complete with handle and 3 screw fixing base. Change over shaft actuated contacts for telephone ringing, shocking, etc., suitable for converting Don. V. phone to bell call 37/6
Post: Vic, 3/-; Interstate 4/9.

8-DAY CLOCKS

IDEAL FOR CARS AND TRUCKS
Precision built in America by the famous Waltham Clock Co. for the NS Navy and containing the highest quality movements. Special features include: 24-hour dial, sweep secondhand, tells civil date, handy size (3½in dial), and chronometer-like accuracy.
OUR PRICE £9/10/-
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MAKE YOUR OWN FISHING ROD

FROM A TANK WHIP AERIAL: Two 4ft tapered sections of tubular spring steel, by the simple addition of a butt and runners, you'll have a rod fit for a champion.
DISPOSALS PRICE 15/-
Freight forward rail.

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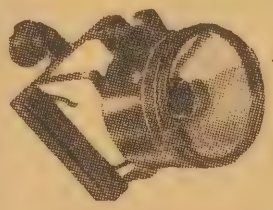


R.A.F. SIGNALLING LAMPS

Ideal for night shooting, 5" reflector, twin handle grips and trigger switch, both 12 and 24 volt available. All in "A1" condition.
DISPOSALS PRICE 30/-
Postage and Packing, Vic., 5/-; Interstate, 7/6.

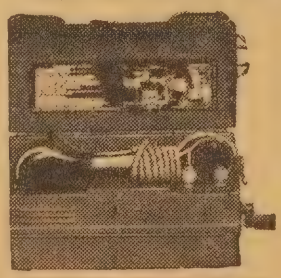
Build Your Own Dumpy Level

With the "ASTRO COMPASS," a precision built instrument, originally used for finding the direction and bearing of an aircraft, this instrument can be made (with slight modification) into an accurate dumpy level. Containing declination scale with micrometer adjustment, azimuth circle, 2 cross levels and adjustable turntable mountings. IDEAL FOR THE HOME BUILDER.

Disposals Price . . . 59/6

Post & Packing: Vic., 3/9; N.S.W., S. Aust., 6/-; Qld., W.A., 8/6.

INSTAL YOUR OWN TELEPHONE SYSTEM



No rental, no upkeep! Simple to instal, just connect two units with twin wire. A bell ringing generator is incorporated and BATTERIES OR POWER ARE NOT REQUIRED. Each unit is contained in a strong waterproof case. Ideal for home, farm, office or factory.
Price per set of 2 phones
£9 15 0
100yd Reels of Twin Wire, 27/6

A HIKER'S COMPASS

Fitted with adjustable circle and reflector attachment for taking bearings. Contained in a bakelite case 2½" x 2½" with thumb ring. Calibrated in points and half points with luminous markings and complete with stabilizer. (Card locks automatically when case is closed).

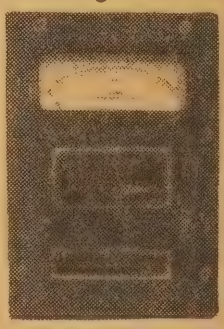
PRICE 29/6

Post and Packing: Vic., 1/6; N.S.W., S.A., Tas., 2/6; Qld., W.A. 3/-.

TELEPHONE HANDSETS

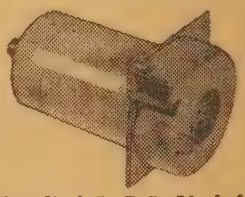
STANDARD P.M.G. TYPE
PRICE 39/6
Postage and packing Vic, 2/-; NSW, SA, Tas, 3/-; Qld, WA, 3/9.

Bonding Testers



Low Resistance Measuring Sets, calibrated scale 0-0.1 ohm.
Price 35/-
Postage: Vic, 3/-; I'state, 5/-.

Blower Motors



24 volt A.C. D.C. Ideal for small ventilating jobs. Price . . . 39/6
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Aldis Sighting Telescopes

Weight 1 lb, length 13½", diameter 1". Fitted with cross lines. Suitable for use with the Astro Compass (above left) as a sight for levelling.
PRICE £2/5/-
Postage and Packing: Vic, 3/-; NSW, SA, Tas., 4/6; Qld., WA, 5/-.

Build Your Own Light and Power Plant
Battery Charging Generators

12 volt	500 watt	£9	19 6
24 volt	1000 watt	£12	10 0
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50-0-50 Amp Meter (Ferranti)		£2	10 0

The above 24 volt models can be used as 32 volt without any alteration.

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"UNIVERSITY" KITS

are easy to assemble. A screwdriver, pliers, a soldering iron are the only tools required.

MKI. MULTIMETER

This kit will build a first-class instrument with the following ranges:—0-1; 10; 50; & 250 milliamps. DC. 0-10; 50, 100; 250 & 1000 DC, AC or Out-Put Volts. High & Low Ohms from self-contained battery. A large rectangular meter and crackle - finished case with handle ensures a professional finish to this instrument. A complete easy to follow instruction book is supplied.

£11/5/-

Plus Postage

OKI. OSCILLATOR

An efficient but simple battery operated oscillator can be built from this kit. It covers the useful ranges of 160-490 Kc; 550-1600 Kc and 16 to 45 metres. A pre-aligned coil unit is included so that no calibration problems arise. The front panel is fully engraved with calibrated dial scales, range switch and attenuator. Metal case is crackle finished and fitted with handle. Instruction book supplied.

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Plus Postage

PRICE'S RADIO

5-6 ANGEL PLACE, SYDNEY.

2 pm all in attendance will assemble as above for introductions.

The first competition takes place between 4 and 6 pm for the G. Challender Remembrance Trophy. First prize is a replica of the cup and £5.

Second prize £2. Stations participating will contact as many stations as possible within the perod on the 40-metre band. Portable gear will be used and power not drawn from the town supply. While there is no power limit scores will be adjusted on a power basis.

General entertainment in the way of pictures, dancing, cards, etc., will be available on Saturday evening, while a fishing competition commences at 6 pm and concludes at 9 am Monday. A silver cup is available for the competitor catching the largest fish.

At 7.30 pm Ted Gabriel VK2AVG, will lecture and demonstrate on the latest type of tape recorder plus other interesting lectures, and at 9.30 pm an investigation into the elements of an 18 watter.

The search for the hidden transmitter on 144 mc/s takes place at 10 am Sunday. The transmitter to be within four miles of Urunga and will be operated by Neil Hanson, VK2XY. First prize is a replica of the cup and £10, second prize £5.

The final competition — the Urunga Scramble for the URD Trophy—will be run between 3.30 and 4.30 pm. First prize replica of the cup and £3, second prize an 813. Using any equipment, any band and any power, the station that contacts the most stations in the hour will be the winner.

During the afternoon the ladies present will meet the Bellingen Quads when Mrs. Percy Sara will attend. Sunday evening will be devoted to official welcome and concert items.

Monday will be devoted to a general get-together.

The committee for the convention is as follows: President: Hart Wall, VK2JC. Committee: Noel Hanson, VK2AHH; organiser, Crieff Retallick, VK2XO; secretary, Percy Sara, VK2QV; publicity, Dave Evans, VK2AYE; entertainment, Ivan Sherman, VK2IS; ladies' entertainment, Jack Gerrard, VK2ADN.

You are assured a very pleasant Easter if you can make Urunga—let VK2XO, 2ARY, 2AHH or 2QV know of your intentions.

Dx and Personal

THE International Amateur Radio Union now issue a special Worked All Continents' Certificate for 3.5 mc contacts.

If you have the required six QSL cards they should be forwarded through the local division of the WIA for perusal. The certificate will be then forwarded direct from the IARU Headquarters Society the ARRL.

Competitors in the Ross A. Hull UHF Memorial Trophy Contest run over the holiday season, enjoyed the best conditions yet experienced on the 50mc band. Interstate, NZ and New Guinea openings occurred practically daily and VK5BC recorded something in the region of 450 contacts in the contest. VK9XK made about 150 contacts, while NZ tallies are not known.

Scores will be much higher than last year and many stations had over 100 contacts.

Records on 144mc band were shattered during the period and distances very close to the world record figure of 1400 miles were covered.

The first contact was made on December 15 when Allan Llewellyn, VK2AH, was in communication with ZL3AR over a distance of 1340 miles. Signal strengths reach S8 at times and held for about 10 minutes. The second was between Clem Tilbrook, VK5GL, and Rollo Everingham, VK6BO, over approximately the same distance. The distances covered were over 1000 miles in excess of the previous Australian record.

Congratulations to the amateurs concerned, and would appear as if an Australian station should soon be the world record holder.

YOUR OPPORTUNITY

to join the world-wide ranks of amateur transmitters! The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operators Certificates of Proficiency.

Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.

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Red and Black Oxide Plastic and Paper complete with plastic spools.

On 5" Plastic Spool (612')
Paper base **28/6** nett (Retail).
Plastic base **44/-** nett (Retail).
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Plastic base **63/4** nett (Retail).

- High coercive-force black oxide paper in 7" or 5" specially recommended for low speeds 3¾" or 7½/sec.
- Frequency range 30"/sec. 30-15000 cps plus-minus 1db.
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- Harmonic distortion plastic 1.5 — 2%, paper 2—3%.
- Signal to noise ratio plastic 60 db, paper 50 db.
- Stability plastic ¼ db, paper ½ db.
- Elongation plastic 1.5%, paper .5%
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- Particle size a half to a third micron.
- Cross-talk between layers—none.
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Victoria: Homecrafts Pty. Ltd., 290 Lonsdale St., Melbourne.
Queensland: E. V. Hudson Ltd., 316 Adelaide St., Brisbane.
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PYRAL PERFORATED TAPE 8mm., 16mm., 35mm. soon available at our store.

TAPE RECORDERS

The following Tape Recorders are now available at our Sydney Showroom:—
"MAGICTAPE" twin-track units which give one full hour's recording on a 7" spool of Pyral Tape. Ideal for musical reproduction, but could be used for office dictation work by the addition of a "foot switch" for instantly stopping and starting the machine. Foot switch and headphones can be supplied at extra cost. Delivery eight weeks. Retail Price in N.S.W., **£135/8/4 nett.**
"FERRY" Recorders full track, excellent die-cast construction. Input level meter, timer, composite head, uses Pyral Tape. Immediate delivery. Retail Price in N.S.W., less microphone, **£91/16/- nett.**
"CLIFTON" English Recorder, just arrived. Retail Price, less microphone, **£124/6/3 nett.**
Come into our showroom for a free demonstration or our sales representative will call and demonstrate.

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RADIO BENDIX MN.26.C COMPASS RECEIVERS

Huge Purchase, 300 Brand New in Original Cases

THE LAST OF THESE RECEIVERS THAT COST £286/-/-

The saving in cost on this purchase passed on to YOU. This is the finest broadcast receiver ever offered. 12 valve. Operates from 24V. Converts easily to 240V-AC also 6V, 12V or 32V.

COMPLETE WITH 12 VALVES and CONVERSION CIRCUIT

£15/17/6

LESS MOTORS £14/5/-
LESS VALVES £10/10/-

Completely converted, including Speaker, Dial and Control Panel, fitted, tested and Dial calibrated ready for use.

6V. D.C. Operation	£29/17/6
12V D.C. Operation	£29/17/6
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THE CONVERTED RECEIVER

with 55 to 1 ratio dial. 8" speaker in bakelite cabinet.

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Chassis fitted for S/W Converter

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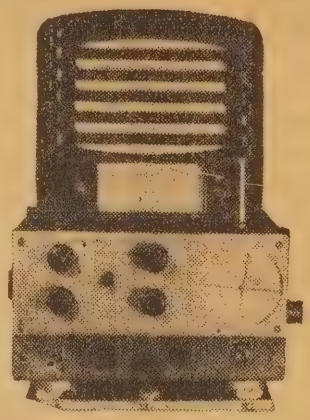
THE MOST SENSITIVE SET AVAILABLE IRRESPECTIVE OF PRICE



CONTROLS:

Volume, Sensitivity B.F.O. Tone & Tuning Wave Change Switch

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DIRECT RECEPTION of Europe, USA, and Asia on the Broadcast Band.

VALVES USED 2 6J5 2 6N7 1 6F6 1 6B8 1 6L7 5 6K7 IF FREQUENCY 112KC.

Coverage 3 Band. 150KC to 1500KC. An outstanding receiver with a sensitivity of 1 microvolt. Ideal for home use, cars, boats or communications and amateur use as Q 5er on 455 or 1600KC.

A.W.A. TELE RADIO TRANSMITTERS

A.W.A. small ships' units. 12 volt operation. 3 to 9 meg. Air tested including 1 crystal to required frequency **£25/-/-**

A.T.R. 2-B TRANSCEIVERS 20 WATT

Air tested. Including 1 crystal to required freq. 3 to 9 meg., 12 or 24V. 240V AC, £45/-/-. **£47/10/-**

A.T.R. 4-B TRANSCEIVERS

A dry battery powered unit. Crystal controlled. 3 to 8 megs. Air tested. Complete except for batteries. 1 crystal to required frequency.

£27/10/-

No. 11 TRANSCEIVERS

12V operation converted to crystal control. Air tested. Including crystal.

£27/10/-

R.C.A. AMERICAN INDICATOR UNITS

For that oscilloscope. Complete with 8 valves. 5 B.P.I. CRO.

£8/15/-

CRYSTAL CALIBRATORS

A.W.A. units including valves. 100KC and 1000KC crystals. 6V vibrator supply.

£15/-/-

CROSSLEY TRANSMITTER RECEIVERS

3.8 to 5.8 meg. less valves. Including 200kc Crystal & Circuit and Transport Case .. **£6/15/-**

HIGH VOLTAGE CONDENSERS

4000v. Working. 1.5 mfd. OIL FILLED **15/-**

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30-Hour Elgin Movement 1-Minute Sweep Hand, Electric Switching. Ideal Photographic Timer **17/6**

101 VIBRATOR POWER SUPPLIES

6v. Input 225v. Out.

£4/10/-

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RECEIVERS—TEST & P.A. EQUIPMENT, POWER SUPPLIES TRANSMITTERS, TRANSCEIVERS

TOP PRICES

HEAD PHONES

Low Impedance

NEW, 12/6. USED, 7/6

Postage: NSW, 2/6, Interstate, 4/-

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5 VALVE---DUAL WAVE RADIOGRAM CHASSIS

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FOR MICROGROOVE OR STANDARD RECORDS

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Alternative Motors or Speakers if required. Garrard Auto Changer £8/10/-. 12" Speaker, £1 extra. Packed free for airfreight or passenger rail, goods rail, 15/- extra.

£27/17/6

SUPER 6 RADIOGRAM

R. & H. November.

The complete kit, including valves and 12in speaker.

£28/5/-

ADVANCE 52 RADIOGRAM

R. & H. January.

Incorporating Variable Selectivity, L.P. & 78 Compensation

Latest Miniature Valves **£24/10/-**

Dual Wave 15/- extra

TWIN SPEAKER MANTEL

Complete with 2 speakers and cabinet.

£19/17/6

LITTLE GENERAL 1951

Complete with cabinet.

£16/17/6

JUBILEE PORTABLE

R. & H.. December.

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OFF THE RECORD — NEWS & REVIEWS

Are special speaker enclosures necessary? Will I get better results if I take my loudspeaker out of the radiogram cabinet? What's the best way to go about it? How much better will it be? Just a few question which keep recurring in the mail more particularly during the last few months.

By JOHN MOYLE

MOST of my correspondents seen to divide themselves for the purpose of this discussion into two sections — those who have some technical knowledge of amplifier work generally, and those who haven't, but are keenly interested in getting better results.

TWO CLASSES

The first category is able to make some kind of selective judgment when reading about new ideas and new methods of doing old things. The second is obviously a bit bewildered about it all, and anxious to seek some guidance to avoid wasting time and money.

To offer advice might seem fairly straightforward at a glance. Actually, it is far from being easy. The more informed enthusiasts will, on inquiry, be found to have much more in common than the less technically minded. Most of them have bought or built good amplifiers which conform more or less to the same general pattern of good output, quality and the fact that they are hitched to good quality speakers and pick-ups. In addition, these readers have a clearer idea of what they want, and are in various stages of achieving it.

In other words, playing around with amplifiers and associated apparatus is their hobby, and they are ready to spend time and money on their failures as well as on their successes.

But class two, will, in all probability, never become members of class one. In some cases they just haven't got the technical approach to the subject, and in others, the time or inclination to worry themselves about circuits and stuff.

They are happy to let the better informed do the work and advise them about the results. All they want to know is the best solution to the various problems, and how to go about applying these solutions to their own circumstances.

It is this fact that makes it hard to give them the right answer. Lots of people ask me whether they would be wise to buy a loudspeaker costing about £20 to improve their equipment. Now, how can I answer that one to suit all inquirers?

FIRST CLASS

I know, for instance, that Alfred wouldn't appreciate the difference, if any, the speaker would make, because he is in love with a large collection of 78's in various stages of repair, and plays them with an old type pickup which suits his gear better than a new lightweight. I know than on some of his records the new speaker would sound fine. But I know also that, on most of them, it would only bring up distortion and high surface noise to an intolerable degree.

Whereas Richard has picked out the best records from a technical viewpoint, has a nice large room where a big speaker can be heard to advantage, and uses a pickup which, although quite good, hasn't too wide a range to show up high frequency troubles. Moreover, his plans include the use of microgroove pickup and the addition of LP records for the future.

It might be OK to hazard an opinion for these two, negative for Alfred and positive for Richard. Particularly as Richard is quite able to handle the job of fitting extension leads, &c., which will be required, whereas Alfred wouldn't know whether to use a soldering iron or a ball-point pen.

TAKE CARE!

That's why I am frankly most cautious about making recommendations of this kind, particularly where a large sum of money is involved. The best way to lose friends is to advise the use of expensive equipment, only to find that for various reasons it doesn't give the results hoped for.

I think, however, it is fairly safe to say that in nearly every case, it does pay to get the loudspeaker out of the average radiogram cabinet and to mount it in a separate speaker enclosure. This is particularly true

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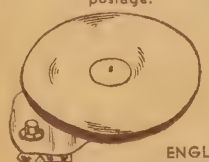

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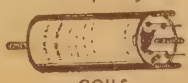

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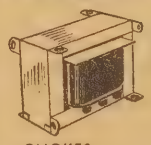

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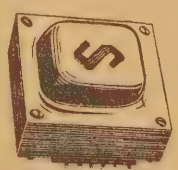

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if the speaker is a good one of 12in size.

Commercially made radiograms are forced to compromise by putting everything into a single cabinet. Only de-luxe equipment costing a goodly sum ever sold successfully in separate units — mostly of the "custom built" variety. The average buyer wants to have it all in a single shiny cabinet.

But such a cabinet isn't the best for the speaker, although almost any structure will do to house the "works." Most cabinets today must be cut to the bone to keep the prices down, and they are pretty flimsy. Generally they have their own resonances, which show up badly, particularly when the volume is turned up.

Probably the best mount for the average man's speaker is the vented enclosure, about which many articles have appeared in our magazine and elsewhere. This box is made of heavy wood, about ¾in thick—generally plywood—and is dimensioned to smooth out the bass response and give much better reproduction at the bottom end than the average cabinet. Its baffling efficiency is incomparably better, and the speaker will produce more and cleaner sound for the same amount of "volume" produced by the set.

SIMPLE TO MAKE

Manufacture of such enclosures isn't at all hard, and quite within the capacity of the home carpenter. The actual shape isn't critical, and corner mounting enclosures are just as good as ordinary four-sided oblongs. I have demonstrated this point more than once by taking a 12in speaker from a friend's set and screwing it into my original vented enclosure that came from America about 15 years ago. I've never yet heard a speaker that didn't sound much better that way.

Specialists and technicians can nearly always "tune" such a box by juggling its dimensions to give slightly better results than by using standardised measurements. But in practice, and for our purpose, it isn't necessary to worry too much about such pruning—the speaker will still sound much better than it did.

Another point the ordinary man can appreciate is that the enclosure stops any sound being radiated into the air from the back of the speaker. It all comes from the front, and this undoubtedly does clean up reproduction on nearly all types of records.

But an advantage at least equal to any I have mentioned is that no longer need the operator sit close to the loudspeaker in order to avoid walking across the room to change records or to tune in.

PLACEMENT

It is hopeless to expect good volume and dispersal of sound through the room unless the speaker is placed in the spot where it sounds best. One spot where it will sound worst is just where it must be—a couple of feet from the listener, within easy operating reach.

If you have a reasonable-sized room you'll find listening a very much more relaxed business if your speaker is over the other side, preferably at the "narrow" end. You'll be able to play it much louder without being oppressed by the sound, and the speaker will be able to make full use of the air capacity of the room in developing the sound before you hear it. Even if your room isn't very big, you'll still get the advantage.

Although I've mentioned particularly 12in speakers, the same thing is generally true of smaller types which, of course, use smaller enclosures. Generally their bass response isn't as good as the bigger types, but the enclosure can be so dimensioned as to greatly improve it in this respect, and to reduce its tendency to boom at its higher resonant frequency. You'll get cleaner, crisper sound, to put it non-technically, particularly noticeable on voices.

Another thing I like about these enclosures is that with them the speaker is mounted invariably several feet up in the air, and not down somewhere near your feet, as with so many radiogram and radio cabinets.

SOUND SOURCE

If you sit close to the set, or it is behind your chair, could you think of a sillier place for sound to originate? If you had the announcer in your room, you'd sit him in a chair where you could face him, and hear what he was saying. If your friend played the violin, you wouldn't expect him to squat on the floor to do it.

To develop this one much further would mean a talk about room acoustics. This would inevitably mean selecting special cases, so I'll leave it at that.

Now what about buying a better, rather costly speaker in place of the present one? Would that be worth while?

By a better speaker we generally mean an imported type, probably with a double cone and a very wide frequency response.

These speakers sound fine when properly used, but disappointing if not. If connected to radiograms using ordinary 78 records and old type pick-ups they won't give much improvement except possibly better and bigger bass. But they will greatly increase any distortion and surface noise which the limited-range speaker doesn't show up too badly.

You will almost certainly have to install with such a speaker a top-cut filter unit of a type we have described in the past, to chop down on the highs, according to how bad or how good your records are.

ON RADIO

On radio things won't be quite so bad, because the average set cuts the highs pretty severely anyhow. On direct broadcasts, the new speaker will probably sound fine.

The point is that, with a wide-range speaker, you have got to supply clean, wide-range input. I'd say that only with a good, microgroove pickup running through a compensation stage (as with our Playmaster series), and using good microgroove records, would you get the improved results that would make the new speaker worthwhile.

These speakers are rarely suited for the speaker transformer with your set. You would have to buy a new transformer to match the new speaker, and have it installed at the set. In other words, you'd need the services of a technician, and be prepared to arrange a few alterations to your equipment to justify the change.

The technically-minded reader can probably handle all this in his own home. To him I'd say that, if he is careful enough and can spare the money, he has more than an even chance of gaining. To my non-technical readers I'd say stick to your present speaker.

The extension of leads to the enclosure is generally a simple matter. I've often run leads from a set as much as 30ft, using well-insulated wire, without removing the loudspeaker transformer. I would prefer mounting the transformer in the cabinet, however, and extending the voice-coil leads, but you will probably be successful either way. It's a good idea to drill two small holes in the floor and run the extensions under the house so that you won't be tripping over the wires.

Even if you had to get a radio serviceman to undertake the fitting of extension leads, the job is simple, is not likely to interfere in any way with the performance of the set as such, and should cost little more than the man's time.

If you have a friend who knows enough to build a set for himself, he should be able to do the job for you, as it involves only the lengthening of wires which are already in the set.

WILL IMPROVE

So, to answer in summary the questions posed at the commencement of this article, I'd say that a vented enclosure of the right size will improve the results of almost any set. The improvement will mean better bass, cleaner reproduction, and more sound for the same input. Every bit as valuable is the ability to place

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OFF THE RECORD

(Continued from Page 91)

the speaker where it sounds best, irrespective of where the set stands.

Your present speaker should be used unless you are able to enlist the services of a competent technician who can steer you away from the pitfalls of connecting a wide-range speaker to an outfit not suited to it. But a good technician could probably fit a new motor, pick-up and pre-amplifier for high-class microgroove record reproduction which would make the expensive speaker worthwhile. This operation would, of course, cost extra money.

There are some speakers of the single cone variety which are really better quality examples of the single cone Australian-made types fitted to the better class radiograms.

These cost something like £10 each, and, in an enclosure, will often show up better than your present speaker.

In most cases it would be safe and worthwhile to buy such a speaker for your enclosure, with little risk of the troubles peculiar to the twin-cone wide range types. If your present speaker is a 12in type, the difference will not be as marked as it would be if you now have an 8in speaker. In the latter case there is almost certain to be a very big improvement.

Incidentally, it is quite practicable to fit a good speaker in an enclosure to a mantel set, if it is of a good make. The works of a mantel set are, generally speaking, the same as those of a larger type, apart from some of the real baby types.

Many readers use an arrangement which allows them to plug into a socket mounted on their sets either the present built-in small speaker, or the larger job mounted in the enclosure.

It's not a hard job to have this modification made to your set, and you'll be amazed at the difference. Many of the larger mantels are also suitable for the attachment of pick-ups, but which, because of the limitations of the small speaker, are rarely used. The plug-in speaker arrangement makes the use of a pick-up just as practicable as with a bigger set.

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LINING UP A D/W COIL BRACKET

(Continued from Page 33)

trimmer, of course, is then lined up for loudest volume.

Tune up to 2FC and line it up on the dial by screwing the iron core in or out of the oscillator coil. The aerial coil is adjusted by the same method. There is no padder condenser to adjust. A fixed condenser is wired in the unit.

If you have had to move the oscillator core very much, you may find that 2SM has now slipped out of position. So go back to it, and using the trimmers, line it up once more. Back again to 2FC to make sure it hasn't been upset by this last change.

Backwards and forwards two or three times in this manner will make certain that the broadcast channel is correctly lined. A final check is made with the aerial trimmer at the high end of the band on a weak station or on noise level.

The short-wave band is aligned in exactly the same manner as the broadcast band, using the trimmers at the high frequency end of the dial, and the cores at the low frequency end.

With the coil bracket lined up, you can now consider the IF transformers. These are lined up at the factory, but the extra capacitance of the wiring you have added, and of the valves, will inevitably throw them a little off their correct frequency.

Do not touch them until the bracket is aligned, and do not touch the bracket while lining the IF's.

Most IF transformers now have iron cores, and are adjusted by screwing these in or out. Because the IF's were initially adjusted at the factory, it is unlikely that your alignment will involve more than one or at most two turns. Before moving any of the cores, make a mental note of the original position so that you can come back to it if necessary.

Select a weak but steady station somewhere on the dial, it doesn't matter where. One by one, try the iron cores on the IF's, commencing with No. 1 and proceeding to No. 2. If you find that a small movement of the cores improves sensitivity, adjust for this best spot.

The winding connected to the diode is much broader than the others, and its core setting is much less critical.

When lining for final adpustment, always use a weak station, or simply use the noise level of the set. Otherwise the action of the AVC will flatten out the peak of your adjustment.

If you have access to a modulated oscillator or signal generator, your job will be easier, particularly if you can read the output of the generator on an output meter. In this case, start first by aligning the IF channel, and proceed then to the bracket. Always use a weak signal from the generator when making final adjustment.

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ANSWERS TO CORRESPONDENTS

N. R. (Yarrabin) wants to know if pickup terminals can be fitted to the Vibra-Five.

A.: It should be possible to feed a pick-up into this circuit, but the connection from grid to chassis is not likely to be satisfactory. The normal method is to use a simple change-over switch to disconnect the volume control from the IF transformer and transfer it to one of the pickup terminals, the other terminal being connected to the chassis. However, it is unlikely that this circuit will have sufficient gain for use with a microphone, unless it has a very high output, while much the same will apply to the guitar. Since we are not familiar with the circuit of the commercial receiver you mention we cannot compare the two.

L. A. B. (Tailem Bend, South Australia) wants to convert an AC set to operate from DC, using the valves already on hand. He also requires a circuit of an amplifier to operate from the DC mains.

A.: Unfortunately there is no very simple way out of this problem and we have no circuits on our files designed for DC operation. The usual approach is to operate the valve filaments in series with a heavy duty resistor to reduce the voltage to that of the filament network. In order to keep the current drain of this network within reasonable limits it is usual to select types having high voltage ratings, such as the 12 volt series for the early stages or the set and 35 or 50 volt types for the rectifier and output valves. A barratter lamp is often used in place of a resistor and is to be preferred. The main voltage is then used for the HT supply, usually with some form of filter such as an electrolytic condenser.

It must be realised that receivers of this type need to be very carefully constructed and handled if they are to be absolutely safe, and we cannot too strongly emphasise the danger to the inexperienced worker which is presented by a receiver or amplifier without the normal power transformer.

An alternative suggestion is to use a six volt accumulator for the filament supply (assuming some convenient method of charging is available) and the mains for the HT. This also applies to the amplifier position, the scheme having the advantage of permitting the use of normal six volt type valves throughout.

We regret that we cannot undertake the design of special circuits for individual readers.

M.K. (Hong Kong) wants to know what valve can be used as a substitute for the 6AR7 as specified for the "Learn While You Build It" series and suggests that the 6K6 might be used.

A.: The 6K6 valve is a power pentode in no way similar to the 6AR7, the 6B8 being about the best substitute for this valve. The transformer you have should be quite suitable, the slight difference in voltage being of little importance. It would be possible to use a short wave version of the Reinartz coil, but the short wave coils normally available commercially would not be suitable, and it is usual to make this type rather than buy it. We have a pamphlet available on winding such coils which is available through our 1/- postal service. We regret that we have no list of receivers such as you suggest, but if we know your general requirements we are generally able to suggest a circuit to suit them.

L.P.B. (Bondi, NSW) forwards a subscription for Radio and Hobbies and inquires about some early issues of the "Learn While You Build It" series. He also inquires about the reason for improved reception in a simple one valve set when the headphone by-pass is removed.

Your subscription has been forwarded to the appropriate department L.P.B. and you should receive an acknowledgment direct. We regret that we have no copies left of the issue you require as quite a number of new readers have been anxious to complete this series. Your simple receiver uses variable plate voltage to control regeneration and the presence of the by-pass condensers tends to make the regeneration easier. These are sometimes necessary with certain types of coils, but aparently in your case they have caused regeneration to occur before a reasonable voltage has been applied to the plate. A similar effect is sometimes experienced when the screen voltage is used for control purposes and it is often necessary to modify the coupling between the grid coil and feedback winding or adopt other measures to reduce the feedback.

T.B.S. (Singapore, Malaya) sends along a contribution to the "Reader Built It" page of the magazine.

A.: Thanks, T.B.S. We are holding your contribution in case we can find a place for it in the "Reader Built It" page. We will return your circuit diagram to you as soon as possible.

H.M.S. (Wau, New Guinea) forwards his subscription and advises of a change of address.

A.: Many thanks H.M.S. for your subs. The matter has been dealt with by the subscription department and you should have received their official receipt by now. We are pleased to note your favorable reaction to the contents of the magazine and we hope that each issue will continue to appeal to you in the same manner.

B.C. (Nundah, Q.) wants to know how to connect a 2in speaker to the "IQ5-TWO."

A.: Without exact details of the speaker we are unable to advise whether the speaker could be used or not but in any case the output from this set is hardly sufficient for loudspeaker operation particularly considering the low efficiency of the smaller types. If the speaker is fitted with a high impedance transformer it could be simply connected in place of the phones, but we doubt if the results will be very startling.

J.A.N. (Dargo, Vic.) asks about the reconditioning of a car accumulator.

A.: We replied to your query in last month's columns, J.A.N., to the effect that we could give you little assistance. However, B.H., of Berala, NSW, reminds us that an article on this subject was reprinted in the December, 1942 issue. The general text of the article which was in connection with the treatment of sulphated accumulators, was to empty the cells, wash out twice with distilled water and fill with a 20 pc soultion of sodium sulphate (200 grm. per litre) or commercial Glauber's Salts (4oz per pint). Charge the accumulator two to three times the normal period, then drain and fill with acid of specific gravity of 1.25.

B.L. (Guildford, NSW) has built the "Reflex Two" which at first performed satisfactorily but subsequently failed while the volume control was being operated. He wants to know if we can suggest the possible cause of the trouble.

A.: It is rather difficult to give a definite solution to this problem, but, since the volume control appears to be involved, this would be the first component to suspect. The most likely fault would be the failure of the moving arm to make contact with the resistance winding, and this would cause symptoms similar to those you describe. We suggest that if an ohmmeter is available that you check this component and also, if possible, check the remainder of the set for voltages &c. Since the set performed correctly for a time, it would suggest that the wiring &c. is correct and that the failure is due to the failure of a component. If you are unable to check the components yourself it may be necessary to enlist the aid of a competent serviceman.

B.H. (Berala, NSW) sends in some information for a reader of these columns.

A.: Many thanks, B.H., for your letter reference the article on the treatment of sulphated accumulators. We have inserted the details in these columns for J.A.N. (Dargo, Vic.)

T.S. (Melbourne, Vic.) would like to know why many modern tuning coils have the windings enclosed in metal cups. He also asks a question regarding the coverage of shortwave coils.

A.: As your query is likely to be of interest to a number of readers, we have taken the opportunity of answering it in the "Answer Tom" article in more detail than would have been possible here. The standard shortwave coils which cover from 13 to 42 metres with a 400 pf tuning capacitor would cover from 13 metres to about 30 metres with a 100 pf tuning capacitor so that they would take in the required 25 metre band easily.

NEW ARRANGEMENTS FOR QUERY SERVICE

RISING costs and increasing correspondence have made it necessary to revise the conditions governing our postal query service.

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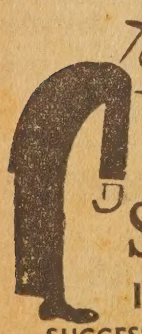

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A HORSEPOWER FROM A CYCLIST

(Continued from Page 11)

ally, and as a basis we should know the powers required on the level in still air. In giving these, however, we can at the same time see how weight affects the question.

We may begin then with the horsepowers required at various speeds on the level by riders of three typical weights, weighing with their machines 150, 190 and 230lb respectively.

Allowing in each case, 35lb for the machine, this would give us a lightweight of 11st 1lb and a heavyweight scaling 13st 13lb. Assuming a rolling resistance of 18lb to the ton and an area of 5 sq ft presented to air resistance, then we get the following results:

H.P. Against Winds

	Calm	Light Breeze	Moderate Wind	Strong Wind	Gale
Wind Miles an Hour	0	7	18	30	46
Speeds m.p.h.	h.p.	h.p.	h.p.	h.p.	h.p.
8	.055	.099	.251	.491	.985
10	.078	.155	.355	.687	1.310
12	.119	.218	.484	.913	
16	.234	.406	.797	1.452	
20	.428	.673	1.255		
25	.798	1.125			

H.P. at various speeds on level

Miles per hour	8	10	12	16	20	25	30
Weight	h.p.	h.p.	h.p.	h.p.	h.p.	h.p.	h.p.
Light ..	.048	.070	.109	.220	.410	.777	1.293
Middle ..	.055	.078	.119	.234	.428	.798	1.319
Heavy ..	.062	.086	.129	.248	.444	.820	1.345

That will give some idea of the terrific effort required for unpaced sprinting, though, of course, for the highest speeds a lighter machine than 35lb would be used. Still, supposing the machine only weighed 20lb and the difference of 15lb was added to the rider's weight, the middleweight would only scale 12st 2lb—not unreasonably heavy.

It is presumed air resistance area is the same in all cases, but middle and lightweights might quite possibly offer a rather smaller area, and in that event their figures would be slightly less at the lower speeds; more markedly so at the higher, for, as will be seen later, air resistance increases as the square of the speed.

This being so, on purpose to avoid complicating the issue, if you cast you eye down the columns you will see the effect of weight, pure and simple. It does not amount to much, but being a constant quantity it naturally represents a far larger proportion of the effort at the lower speeds, where the totals are comparatively small: at 8 miles an hour it means a difference of over 25 pc as between light and heavyweight.

THE EFFECT OF HILLS

Hills, of course, generally entail far more extra effort. In hill climbing the power you exert is made up of the work for overcoming the resistances just sufficiently to roll along the level at a given speed and the work required in the time to raise the weight of yourself and machine to the height entailed by the hill. In the latter, for a given effort, the speed is inversely proportional to the steepness of the gradient: halve the gradient and you could double your speed without more effort—this, of course, entirely apart from the work requisite to overcome rolling and air resistances. How the whole thing pans out in still air for a middleweight weighing, with bicycle, 190lb is shown in Fig. 1.

Compare these figures with those for the middleweight on the level and you will see that it will cost him nearly the same effort to ride up 1 in 10 at 4 miles an hour as on the level at 16; up 1 in 20 at 4 mph practically as much as on the level at 12.

WIND RESISTANCE

Now for the winds. Roughly speaking, in theory the pressure of air varies as the square of its speed: double the speed and quadruple the pressure increases ninefold, and so on. In practice, however, pressures do not appear to follow rigidly this rate of increase, but rise more or less as indicated by the chart on page 11 which has been compiled from a series of actual tests (each marked with a cross). Here the height of the graph line above any speed along the base gives the pressure for that speed.

However, more information can be given in a few figures than in a whole book of words, so here are the figures based on the pressures in the chart. To those who have studied weather it may be explained that in this table the Beaufort scale has been adopted, the wind velocities being as near as possible the middle ones in their respective classes. Also a weight of 190lb has been assumed for rider and machine combined, and the total area offered to wind resistance has been put at 5 sq ft.

In these figures the projected area of rider and machine has been taken without allowing anything for the modified streamlined effect of the more or less rounded parts, like arms, legs, cycle tubes and tyres, so the actual wind resistances might be rather less than those shown. Yet, even if quite a considerable allowance was made for this, the figures suffice to give a fairly approximate idea of wind resistances and to show their relative effects at various velocities.

FOLLOWING WINDS

Incidentally, it might be thought at first sight that a following wind would help one just as much as a head wind of the same velocity would hinder, but, of course, this is not so. Take the case of a man riding at 8 mph against a dead head wind of 30 mph. Now the cyclist will be travelling through the air at 8 mph, but the air, additionally, will be going past him at 30 mph with a total effect of 38 mph, the pressure of which will be around 44lb per sq ft. A following wind will be going past stationary objects at 30 mph, just as when it was ahead, but the rider will be moving in the same direction at 8 mph, so relatively to him the wind will only be travelling at 22 mph, and exercising on him a net pressure of only about 14½lb to the sq ft—an obvious enough point, but even clever people are apt to overlook the obvious, sometimes more so than ordinary mortals.

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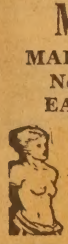

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MAKING AN ELECTRIC MOTOR

(Continued from Page 83).

the connections you will note that before any current can flow from the battery, the commutator segments must be in contact with the brushes. In other words, the current is only flowing for a small part of each cycle of rotation.

For this reason, the average current delivered by the battery is quite small. The motor will turn at a good speed when connected to the smallest 1½ volt cell you can buy, provided the brushes and bearings are adjusted correctly. It takes so little current that the battery would probably run it for a whole day non-stop before becoming exhausted. You can try connecting it to a three-volt battery if you wish, and it will run at a higher speed, but if you try anything higher than six volts there is likely to be excessive sparking at the brushes which will cause their life to be short.

Try to get the highest speed with the motor connected to the 1½-volt battery. To do this, adjust the relative positions of the commutator and armature and also the pressure of the brushes on the commutator. You will probably get best results when the brushes are just touching the commutator wires as the shaft turns. It is better to have the bearings a little on the loose side than too tight.

As the amount of power involved is exceedingly small you can not expect the motor to produce any useful mechanical power. If you require a motor to drive models something larger and more robust is needed.

While most of the other parts for a powerful motor can be made with makeshift materials, it is very difficult to produce a reliable and efficient commutator. For the motor to be self-starting in all positions a commutator having at least three sections is required. Later on, we may be able to describe a powerful self-starting motor using some commercial parts which are generally available.

In the meantime, try making the simple motor. If you get as much of a "kick" out of it as we did it will be well worthwhile.

A HANDY HINT

A HACKSAW blade makes an ideal guide for filing straight edges on work. Make sure the blade is not curved and lock it smooth edge up in a vise with the work as shown. As the blade is so hard that a file will not "touch" it, the work can be cut down to the edge of the blade but no deeper. If the work is comparatively wide, put a blade on each side, aligning them with the edges of the vise jaws.

Faced with the problem of cleaning rust from the threads in a large number of tapped holes, one mechanic did a little experimenting and came up with an unusual thread cleaner. He selected hex-head cap screws which would fit the several sizes of tapped holes and ground a flat across the threaded end of each screw at an angle of about 30 degrees with the axis of the bolt.

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LEARN WHILE YOU BUILD

(Continued from Page 41)

Just before we close there are a few additional remarks we would like to make about the switch. You will notice that the parts list specifies this as a shorting type and there may be some doubt in the minds of beginners as to what is meant by this term. Another expression frequently used, and which means the same thing, is "make-before-break," indicating that the small rotating contact is wide enough to engage the contact it is approaching before disengaging the contact it is leaving.

The opposite type is the non-shorting, or "break-before-make" variety, in which a narrow contact is used and the two fixed contacts are not shorted together as it passes between them.

Ideally, the rear (No. 3) deck should have a non-shorting contact, but it is also most important that the other decks have shorting contacts, and this combination is a non-standard arrangement, available only to special order. To avoid problems of supply we thought it best to design the circuit, if possible, to avoid this requirement.

As it is the only problem arises when the switch passes from the 250 mA position to the ohms position, a momentary reverse current passing through the meter. Since this is only 100 mA through a 250 mA circuit it cannot be regarded as serious and, when handling the switch in the normal way, the movement of the pointer is hardly noticeable. Even if the switch is deliberately moved slowly the meter is in no danger of being damaged, so the objection becomes more academic than anything else. However, if you can get such a combination of decks it is to be preferred and you will understand just how each deck is to be used.

And that's about all there is to tell for this section, except to emphasise that the best way to learn its operation is to measure the resistance of every component you can lay your prods on — which should just about keep you occupied until the next section is described.

RESISTANCE MEASUREMENT

Power transformer primary	70 ohms
Power transformer secondary (centre tap to each side)	220 & 240 ohms
HT to chassis	Barely readable
HT choke	600 ohms
Speaker transformer primary	500 ohms
IFT2	
Primary	9 ohms
Secondary	9 ohms
IFT1	
Primary	10.5 ohms
Secondary	10.5 ohms
Aerial coil	
Primary	2.5 ohms
Secondary	10 ohms
Oscillator coil	
Primary (P & B)	5 ohms
Secondary (F & G)	5 ohms

TO fit a hammer head with a handle that will never loosen, first soak the handle in glycerin for a few days. Rasp it to fit and start it into the head, driving it about half-way through. Next, heat the hammer in an oven to expand the eye in the head. Then finish driving in the handle and insert the usual wedge.

★ ★ ★

Have you ever finished changing a tyre or making some other minor repair on a remote country road and then searched the car in vain for a cloth with which to wipe dust and grime from your hands? After experiencing this difficulty, one motorist placed clean cloths in each of the rear-wheel hubs so that they would always be available when making repairs on the road.

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SELL: F.S.6 complete, as new. Spare 807 —Vibrator—Meter. What offer. **Reedy, Lyster St., Coff's Harbour.**

SELL: Garrard RC65. Also H1-F1 head. Both brand new £21. **9 Banner Rd., Kingsgrove.**

SELL: Hallicrafters model 5 x 28 Super Skyrider complete. Hallicrafters Speaker and Handbook. 240-110 transformer. No. 11 transceiver (Aust.) 4.2 to 7.5 megs. Complete with valves Genemotors RF meter and Aerial Unit "T" (Aust.) for same Type A MK III transceiver. 100 to 250 AC and 6v DC operation vibrator and 3 new spare valves etc. All above in good order. BC375-E Transmitter with valves (5), meters (3) two tuning units 4500-6200 Kc and 7700-10,000 Kc. Best offers by 9/2/52. **E. W. Bailey, 77 First Av., Campsie, NSW.**

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